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NATIONAL DAM INSPECTION PROGRAM. LAKE CHOCTAW DAM (NDS ID-00819--ETC(U)
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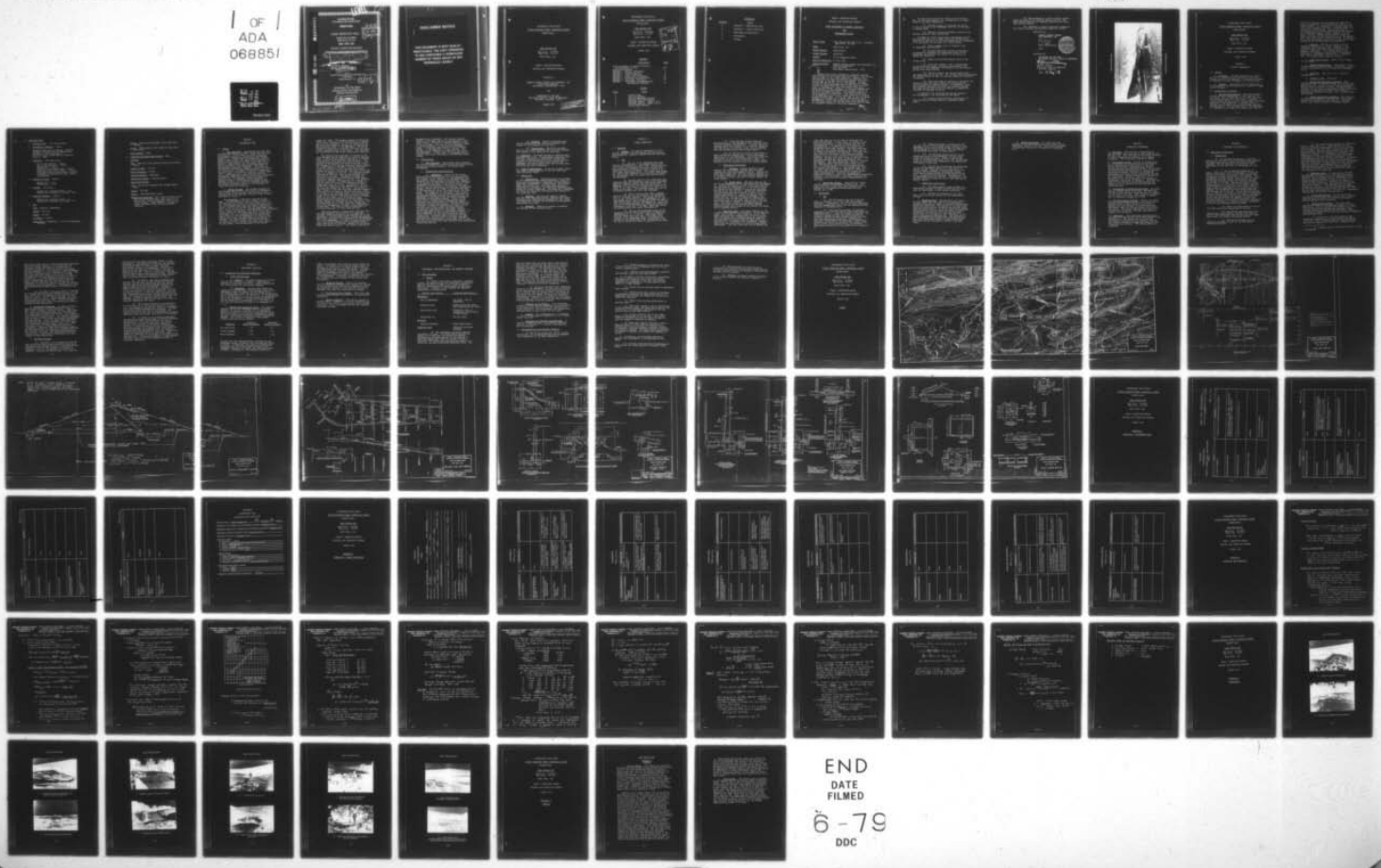

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SUSQUEHANNA RIVER BASIN
LITTLE SUGARLOAF CREEK, SCHUYLKILL COUNTY

PENNSYLVANIA

LAKE CHOCTAW DAM

NDS ID NO. PA-00819
DER ID NO. 54-178

HIGH VISTA, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

(6) National Dam Inspection Program. ID
Lake Choctaw Dam (NDS ID-00819, DER 54-178)
Susquehanna River Basin, Little Sugarloaf
Creek, Schuylkill County, Pennsylvania.
Phase I Inspection Report.

Prepared by
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Consulting Engineers
Harrisburg, Pennsylvania 17105

(12) 89 p.

For
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

(11) AUGUST 1978

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SUSQUEHANNA RIVER BASIN

LITTLE SUGARLOAF CREEK, SCHUYLKILL COUNTY

PENNSYLVANIA

LAKE CHOCTAW DAM

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SUSQUEHANNA RIVER BASIN

LITTLE SUGARLOAF CREEK, SCHUYLKILL COUNTY

PENNSYLVANIA

LAKE CHOCTAW DAM

NDS ID No. PA-00819
DER ID No. 54-178

HIGH VISTA, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

AUGUST 1978

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PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam:	Lake Choctaw Dam (NDS ID No. PA-00819; DER ID No. 54-178)
Owner:	High Vista, Inc.
State Located:	Pennsylvania
County Located:	Schuylkill
Stream:	Little Sugarloaf Creek
Date of Inspection:	27 June 1978
Inspection Team:	Gannett Fleming Corddry and Carpenter, Inc. Consulting Engineers P.O. Box 1963 Harrisburg, Pennsylvania 17105

Based on the visual inspection, available records, calculations and past operational performance, Lake Choctaw Dam is judged to be in good condition. However, the spillway will not pass the Probable Maximum Flood (PMF) or one-half of the PMF without overtopping. If Lake Choctaw Dam should fail due to overtopping, the hazard to loss of life downstream from the dam would be significantly increased from that which would exist just prior to overtopping. Based on criteria established for these studies by the Department of the Army, Office of the Chief of Engineers (OCE), the spillway capacity is rated as seriously inadequate. The existing spillway can accommodate a flood with a peak inflow of 47 percent of the PMF peak flow. If the low areas of the top of embankment were brought up to grade, the spillway would accommodate a flood with a peak inflow of 61 percent of the PMF peak inflow, and the spillway would then be rated as inadequate instead of seriously inadequate.

In view of the concern for safety of Lake Choctaw Dam, the following measures are recommended to be undertaken by the Owner immediately:

(1) Perform surveys to establish the extent of the low areas on the embankment and fill in the areas to design grade.

(2) Develop a detailed emergency operation and warning system for Lake Choctaw Dam.

In order to correct operational, maintenance and repair deficiencies, and to more accurately determine the condition of the dam, the following measures are recommended to be undertaken by the Owner in a timely manner:

(1) Repair damaged area on upstream slope of embankment near spillway.

(2) Perform additional surveys as necessary to accurately determine the downstream slopes of the embankment and evaluate the effects on the factor of safety for stability.

(3) Remove brush growing among riprap on upstream slope.

(4) Until good vegetal cover is established on the downstream slope, the Owner should monitor the condition of the embankment and promptly fill any erosion gullies that might develop.

(5) Visually monitor the two wet areas along the downstream toe of the dam. The outflow should be estimated and records should be kept so that any change in condition is apparent.

(6) Have water samples analyzed to determine the quality of the water and evaluate the susceptibility of the concrete to chemical attack. If necessary, undertake remedial measures to protect the concrete surface. The algae should periodically be removed to examine the concrete for symptoms of attack.

In addition, the following operational measures are recommended to be undertaken by the Owner:

(1) Provide round-the-clock surveillance of Lake Choctaw Dam during periods of unusually heavy rains.

(2) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system procedures.

(3) Implement an annual inspection program of all project features and maintain inspection records.

Submitted by:

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.

A. C. HOOKE
Head, Dam Section

Date:

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
ALBERT CHARLES HOOKE
ENGINEER
No. 2201-E

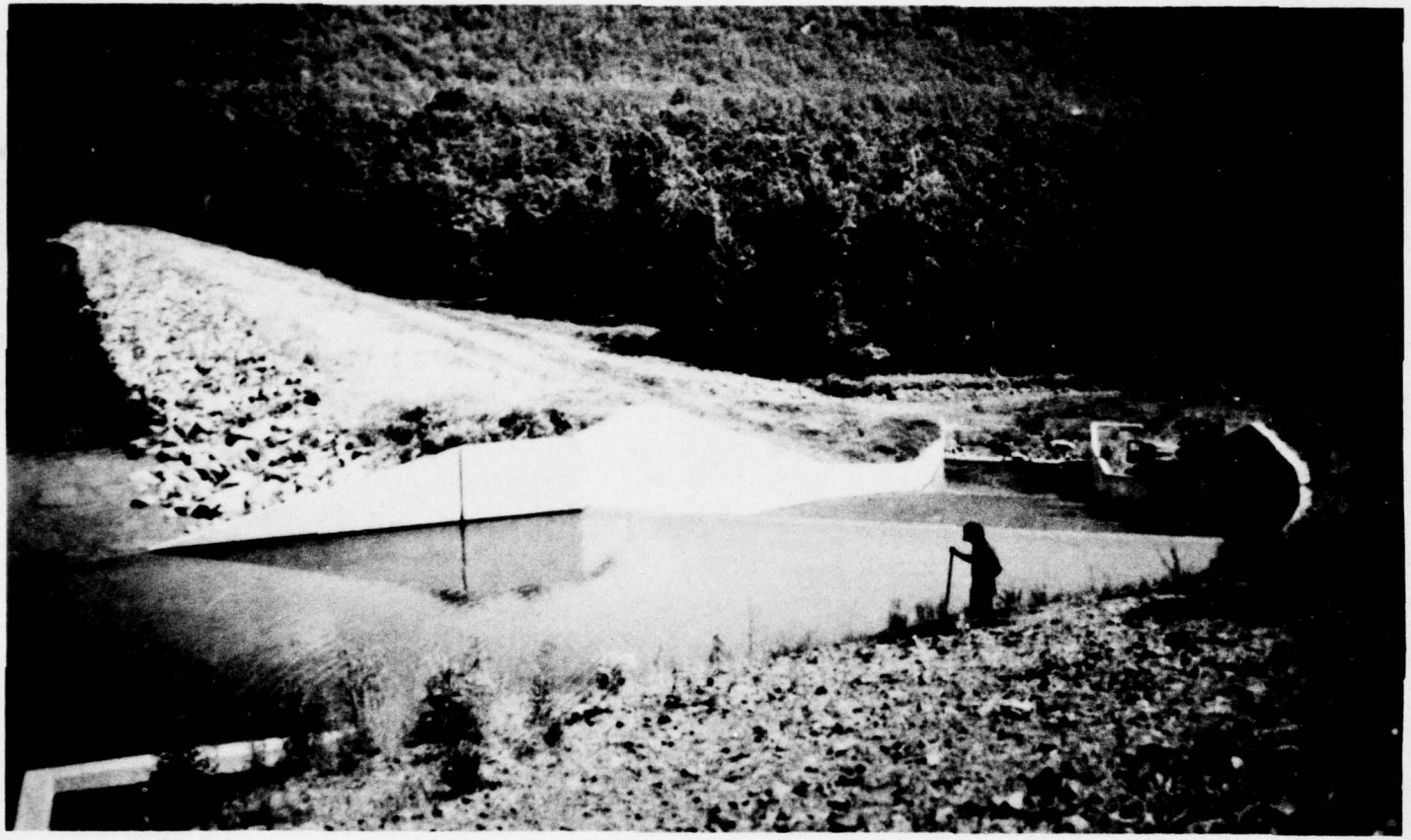
Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

G. K. WITHERS
Colonel, Corps of Engineers
District Engineer

Date: 11 Sep 78

LAKE CHOCTAW DAM



Embankment and Spillway

SUSQUEHANNA RIVER BASIN

LITTLE SUGARLOAF CREEK, SCHUYLKILL COUNTY

PENNSYLVANIA

LAKE CHOCTAW DAM

NDS ID No. PA-00819
DER ID No. 54-178

HIGH VISTA, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

AUGUST 1978

SECTION 1

PROJECT INFORMATION

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Lake Choctaw Dam is a zoned earthfill embankment 32 feet high and 800 feet long. The upstream zone is a clayey sand, and the downstream zone is a silty sand. A shallow cutoff trench having a 10-foot bottom width is located upstream of the centerline. A blanket drain is between the foundation and the downstream sixth of the embankment. The upstream slope of the embankment is riprapped from 3 feet below normal pool level to

the top of the dam, and the downstream slope has a cover of crownvetch. The spillway is located at the right abutment. It consists of a concrete ogee weir with a crest length of 55 feet, a concrete chute, and a concrete stilling basin. The outlet works is located 250 feet from the right abutment and consists of a submerged concrete intake structure, a slide gate, a 36-inch diameter outlet conduit (RCP), an outlet structure at the downstream toe of the embankment, and a gate stand on top of the dam. The features of the dam are shown on the Plates at the end of this report and on the Photographs in Appendix D.

b. Location. The dam is located on Little Sugarloaf Creek about 1.1 miles upstream of the confluence with Tomhicken Creek. Because it was recently constructed, Lake Choctaw Dam does not appear on USGS Maps. It is located about 5 miles southwest of Conyngham, Pennsylvania, in Schuylkill County with coordinates N 40° 56' 00" - W 76° 07' 30". The location map is shown on Plate 1.

c. Size Classification. Small (32 feet high, 430 acre-feet).

d. Hazard Classification. High hazard. Downstream conditions indicate that a high hazard classification is warranted for Lake Choctaw Dam (Paragraph 5.1e.).

e. Ownership. High Vista, Inc., Hazleton, Pennsylvania.

f. Purpose of Dam. Recreation.

g. Design and Construction History. Lake Choctaw Dam was constructed between 1973 and 1974 by High Vista, Inc., as part of a real estate development project known as Valley of Lakes. The engineering services for the dam were performed by Ebeco Associates, Hazelton, Pennyslvania and their subcontractor, Northeastern Engineering Company, Inc., Clarks Summit, Pennsylvania.

h. Normal Operational Procedure. The reservoir is normally maintained at spillway crest level with excess inflow going over the spillway. The slide gate at the intake structure is normally closed.

1.3 Pertinent Data.

a. Drainage Area. 2.55 square miles.

b. Discharge at Damsite. (cfs.)

Maximum known flood at damsite - unknown.
Emergency drawdown line at maximum pool elevation - 160 (approximate).
Spillway capacity with pool at Elevation 1135.1 - 2,560

c. Elevation. (feet above msl.)

Top of dam (design) - 1136.0
Top of dam (low spot) - 1135.1
Maximum pool - 1135.1
Normal pool (spillway crest) - 1130.0
Upstream invert outlet works - 1103.00
Downstream invert outlet works - 1102.28
Streambed at centerline of dam - 1099.0 (approximate).

d. Reservoir Length. (Miles.)

Normal pool - 0.34
Maximum pool - 0.35

e. Storage. (Acre-feet.)

Normal pool (spillway crest) - 276.
Maximum pool (design top of dam) - 430.

f. Reservoir Surface. (Acres.)

Normal pool (spillway crest) - 23.
Maximum pool (design top of dam) - 29.

g. Dam.

Type - Earthfill embankment.

Length - 800 feet.

Height - 32 feet.

Top Width - 20 feet.

Side Slopes - Downstream - 1V on 2.6H Upstream - 1V on 3H.

Zoning - Clayey sand upstream; silty sand downstream.

Cutoff - Earthfilled cutoff trench 10 feet wide at bottom.

Grout Curtain - None.

h. Diversion and Regulating Tunnels. None.

i. Spillway.

Type - Ogee weir with concrete chute and stilling basin.

Length of Weir - 55 feet.

Crest Elevation - 1130.0

Upstream Channel - Reservoir.

Downstream Channel - Concrete chute.

j. Regulating Outlets.

Type - One 36-inch diameter RCP through embankment.

Length - 180 feet.

Access - From downstream outlet.

Regulating Facilities - One 3-foot by 3-foot slide gate at intake structure. Gate stand is at top of dam. Stem is stainless steel in oil-filled casing. Crank operated, 3:1 gear reducer; enclosed rising stem with opening indicator.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. Engineering data that was available for review included a report entitled "Soil Investigation, Choctaw Dam, Big Valley Recreation Development" prepared by Northeastern Engineering Company, Inc., Consulting Soils Engineers, Clarks Summit, Pennsylvania; the construction drawings and specifications prepared by Ebeco Associates, Inc., Hazleton, Pennsylvania; and the permit application report prepared by the Pennsylvania Department of Environmental Resources (PennDER). The report by Northeastern Engineering Company contains the following design data: geologic information; boring and test pit logs; soil profiles; results of direct shear tests, compaction tests, and gradation analyses; recommended embankment designs and results of stability analyses for those designs; suggested compaction specifications; recommended filter gradation; a seepage estimate; and estimated shrinkage factors. The permit application report by PennDER specifies the minimum discharge capacity of the spillway as 2,995 cfs (Curve "C" Criteria).

b. Design Features. The primary features of Lake Choctaw Dam are the zoned earthfill embankment, the concrete chute spillway, and the outlet works. A general plan of the dam and a profile along its axis are shown on Plate 2.

The embankment is 800 feet long and 32 feet high. The embankment section is shown on Plate 3. The top width is 20 feet, and both slopes are 1V on 3H. The upstream slope has 18 inches of riprap on 12 inches of gravel from three feet below normal pool level to the top of the dam, and the downstream slope has a cover of crownvetch. The embankment was constructed with a clayey sand upstream zone and a silty sand downstream zone. The downstream limit of the clayey sand zone is a line extending from the downstream edge of the top of the embankment to a point on the foundation 21 feet upstream from the centerline of the dam. The cutoff trench, which has a 10-foot bottom width and is filled with clayey sand, begins at this point. The minimum depth of the cutoff

trench is 5 feet. The primary purpose of the cutoff trench was to secure a good bond between the embankment and the foundation. A 1.5-foot thick sand and gravel filter blanket is between the foundation and the downstream sixth of the embankment. The filter blanket is connected to a gravel toe drain that has a 6-inch perforated pipe in its center. The toe drain has two outlets at the outlet works outlet structure.

The concrete chute spillway is located at the right abutment and is comprised of concrete approach walls, a 55-foot long concrete ogee weir, a concrete chute section, and a concrete stilling basin. The spillway plan and profile are shown on Plate 4, and details of the spillway are shown on Plates 5 and 6. The alignment of the spillway approach channel begins at a right angle to the axis of the dam and then curves to the left so that the deflection angle between the axis of the dam and the crest of the ogee weir is 51 degrees to the left. The approach channel width varies from 59.5 feet at the upstream end to 55.0 feet at the weir. The approach channel is bounded on each side by cantilever concrete walls that have a maximum height of 12 feet. The approach channel is unlined. The ogee weir is situated so that the depth of water in the approach channel at normal pool level is 3 feet. At the weir, short cutoff walls extend into the embankment on the left and into the abutment on the right. The concrete chute section is 155 feet long and converges uniformly from a width of 55 feet at the ogee weir to a width of 30 feet at the stilling basin. The concrete walls of the chute are cantilever-type and have a maximum height of 12.6 feet. The slab sections are 8 inches thick and are underlain by 8 inches of gravel. Uplift reduction is achieved by 14 pipe drains that extend through the concrete and into the gravel. The stilling basin is 27.6 feet long and 30 feet wide, and it was designed as a U-frame. The sidewalls are 10 feet high. The floor of the stilling basin is horizontal and has a 2.2-foot high end sill.

The outlet works is located about 250 feet from the right abutment and consists of a submerged concrete intake structure at the upstream toe of the embankment, a 36-inch RCP conduit through the embankment, and a concrete outlet structure at the downstream toe of the embankment. A 3-foot by 3-foot slide gate is at the intake structure and is operated from a gate stand on top of the dam. Details of the outlet works are shown on Plate 7. The intake structure is

equipped with a trashrack. The 36-inch diameter conduit is 180 feet long and is supported on a concrete cradle. There are 7 concrete seepage collars along its length. The stem of the slide gate, which is inclined parallel to the upstream embankment slope, is stainless steel and is in an oil-filled casing. It is supported at 8-foot centers. The concrete outlet structure is located at the toe of the embankment. A short reach of riprapped channel connects the outlet structure to the spillway outlet channel.

2.2 Construction.

a. Data Available. Construction data available for review included the project plans and specifications, construction progress reports, and construction photographs.

b. Construction Considerations.

(1) Embankment. Review of the project plans and specifications did not yield any concerns with respect to the character of the embankment work. The progress reports filed by the Resident Engineer indicate that the embankment materials were compacted to the density required by the specifications. The embankment section shown on the plans is the same section that was designed by Northeastern Engineering Company, except that a change in thickness was made in bedding material under the riprap on the upstream slope. The change has no sigificant effect on the design. The gradation of the material specified for the drainage blanket between the foundation and the embankment is the same as the gradation designed by Northeastern Engineering Company. Review of the soils report by Northeastern Engineering Company indicated that several adverse conditions might be encountered during construction: springs at various locations; a strata of compressible, sandy silt on the left side of the stream that might require considerable overexcavation; and highly variable strata that might result in significant seepage. It was recommended that provisions should be made for these conditions as they were encountered during construction. Progress reports indicate that some overexcavation was required in the right abutment area and that springs were located there, but it does not appear that any other major problems were encountered during construction.

(2) Spillway. Review of available data for the spillway did not yield any concerns with respect to the character of that work.

(3) Outlet Works. Review of available data for the outlet works did not yield any concerns with respect to the character of that work.

2.3 Operation. No formal records of operation were available for review. Correspondence indicates that the final inspection by Commonwealth authorities resulted in recommendations to fill erosion gullies, establish cover on the downstream slope of the embankment and remove debris from the stilling basin. This work was later undertaken.

2.4 Other Investigations. As far as is known, there have been no investigations of the dam other than those described herein.

2.5 Evaluation.

a. Availability. Engineering data was provided by the Division of Dams and Encroachments, Bureau of Water Quality Management, Department of Environmental Resources, Commonwealth of Pennsylvania, and by the Owner, High Vista, Inc. The Owner made available personnel for information and operating demonstrations during the visual inspection. The Owner also researched his files for additional information upon request of the inspection team.

b. Adequacy. The type and amount of design data and other engineering data, together with visual inspection and computations performed for this study, are sufficient to assess the condition of the dam and appurtenant structures.

c. Validity. There is no reason to question the validity of the available data.

SECTION 3

VISUAL INSPECTION

3.1 Findings.

a. General. The general appearance of this project indicated that the project features are in good condition. Specific observations are described herein.

b. Dam.

(1) The top of the embankment had some vertical irregularities. The design elevation for top of dam is Elevation 1136.0, but a survey made for this inspection indicated elevations varying from Elevation 1136.8 to Elevation 1135.1, which is 0.9 foot lower than design level. The lowest area occurs in a short reach adjacent to the spillway (Photograph B), but several other low areas were located along the embankment.

(2) Surveys made for this inspection also indicated that the downstream slope of the embankment might be slightly steeper than the design slope. As measured, the slope at two sections was found to be about 1V on 2.6H, which is steeper than the 1V on 3H shown on the plans. The upstream slope could not be determined because most of it was submerged.

(3) Over a 15-foot long reach, located about 25 feet left of the spillway, the embankment was not to design template. The riprap was not to top of dam, the width of top of embankment was less than design width, and the upstream slope was about 2 feet below design template (Photograph B). Along the rest of the upstream slope the riprap was intact and continuous to the top of the dam. Some light brush was growing among the riprap (Photograph A).

(4) The top and downstream slope of the embankment did not have a good cover of vegetation (Photographs A, B, C, and D). Some minor erosion gullies, which were less than 1 foot deep, were visible on the downstream slope. Crownvetch was planted on the downstream slope (Photographs C and D), but it covers only about 25 percent of the slope.

(5) A wet area was located along the downstream toe of the embankment about 200 feet from the left abutment (Photograph J). A slight amount of standing water was visible, but no flow was observed. The area was not particularly soft, and it appeared that the probable source was surface runoff.

(6) To the left of center of the valley a small watercourse begins about 15 feet downstream from the toe of the embankment. The gutter along the downstream toe joins this watercourse. About 0.5 gallons per minute of clear flow was visible, and it appeared that the probable source was surface runoff.

c. Appurtenant Structures.

(1) Spillway. A heavy growth of algae covered all the concrete surfaces that had water flowing over them (Photographs E and F). Some of the algae was scraped away, and the concrete appeared to be in good condition. All other exposed concrete was in excellent condition and had no cracks, spalls, or other defects.

(2) Outlet Works. The gate stand at the top of the embankment was in good condition (Photograph G). Neither the conduit nor the outlet structure had any deficiencies (Photgraph H). A toe drain outlet is located on each sidewall of the outlet structure. Neither outlet had any flow. During the inspection, the slide gate was opened easily to about 1/3 full opening (Photograph G). After closing the gate, it sealed tightly with no significant leakage. The Owner said that the gate is partially opened every six months, and, at the same time, the oil level in the stem casing is checked to insure that it is kept full. The outlet channel is riprapped from the outlet structure to the spillway outlet channel. Some minor gaps were visible in the riprap, but there was no apparent erosion.

d. Reservoir Area. The slopes adjacent to the reservoir are covered with hardwoods. No evidence of creep, rock slides, or land slides was noted. The Owner indicated that sedimentation is not a problem from the standpoint of reduced reservoir capacity. The watershed is entirely owned by High Vista, Inc., and much of it is planned to be developed. However, High Vista has restrictions on cutting trees during development. The only trees that can be removed are

those that must be cut in order to construct the house and driveway. A mine tunnel is located on the left hillside about 0.4 mile upstream from the dam (Photograph K). On the date of the inspection, an estimated flow of 100-200 gallons per minute was coming from the tunnel opening. The Owner said that it drains a strip mine located on the south side of the ridge that defines the watershed. The Owner said that the pH of the water in Lake Choctaw reaches values as low as 3.8 as a result of the acid mine drainage. He also said that a plan to neutralize the acid mine drainage was being considered by the Commonwealth, but that the present status of the plan was unknown. Lake Susquehanna Dam, which is a 50-foot high earthfill dam also owned by High Vista, Inc., is located about 0.4 mile upstream from Lake Choctaw Dam (Photograph L). Lake Calumet Dam, which is a small dam that does not impound any water, is located a short distance upstream from Lake Susquehanna (Photograph M). This dam was apparently constructed without a permit and Commonwealth authorities ordered it to be breached. The Owner indicated that tentative plans call for eventual rehabilitation of this dam.

e. Downstream Channel. There were no visible obstructions in the downstream channel area. The Owner said that a third dam, Lake Algonquin Dam, is planned to be constructed downstream from Lake Choctaw Dam in 1983.

3.2 Evaluation.

a. Dam.

(1) The low area on the top of the dam near the spillway is 0.9 foot lower than design elevation. Consequently, this is the limiting elevation for maximum pool level, and the maximum spillway capacity is determined by it.

(2) The variation between the measured embankment slope and the design slope could lower the computed factor of safety for stability slightly. It should be recognized that the ground surface was irregular because of small erosion gullies and that only two sections were measured. Consequently, additional measurements are necessary to accurately determine the extent of variation from design slopes and to assess the possible effects on stability. Additional discussion of this condition is in Section 6.

(3) Where the riprap is missing and the upstream slope is below design slope, erosion of the embankment could occur during periods of large spillway discharge or by wave action. The light brush growing among the riprap is undesirable.

(4) The existing erosion gullies on the downstream slope of the embankment are not large enough to require filling. However, because the cover on the downstream slope is not well established, there is a potential for deepening of the gullies or development of new ones.

(5) The two wet areas along the downstream toe of the embankment appear to be the result of surface runoff. However, the wet areas are in the vicinity where Northeastern Engineering Company encountered springs during the investigation of the site. If springs should develop, the stability of the embankment could be affected. Consequently, any unusual conditions along the toe in this area are of general concern.

b. Appurtenant Structures.

(1) The algae growth in the spillway is undesirable because it hinders inspection and would mask the development of any adverse conditions.

(2) Nothing was observed in the outlet works that raised any concern for the condition of the dam.

c. Reservoir Area. The existence of a source of acid inflow into the reservoir is undesirable. Although there were no signs of concrete deterioration during the inspection, long periods of low flow could cause the acid condition to worsen and possibly cause concrete deterioration. As far as could be determined from interviews with the Owner and other available information, the quantity of flow from the mine tunnel does not vary greatly, and, therefore, is of little consequence hydrologically. The existence of Lake Susquehanna Dam upstream from Lake Choctaw Dam does have significant effects on Lake Choctaw Dam. These effects are discussed in Section 5 of this report.

d. Downstream Channel. No conditions were observed in the downstream channel that might present significant hazard to the dam. Additional discussion of downstream conditions is presented in Paragraph 5.1e.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure. The reservoir is maintained at spillway crest level with excess inflow passing over the ogee weir. The slide gate at the intake structure is used to drawdown the reservoir or to augment streamflow. The slide gate is normally closed.

4.2 Maintenance of Dam. The dam is visited daily by the Assistant for Construction and Maintenance, who is responsible for maintenance of the Lake Choctaw Dam and Lake Susquehanna Dam, which is located upstream from Lake Choctaw Dam. The Assistant for Construction and Maintenance is responsible for observing the general condition of the dam and appurtenant structures and for determining the need for maintenance. Formal inspections of the dam are not conducted by the Owner. The cover on the downstream slope of the embankment is crownvetch; consequently, no mowing is necessary. The brush and weeds on the upstream slope growing through the riprap are cut or sprayed with an herbicide when deemed necessary.

4.3 Maintenance of Operating Facilities. The slide gate is operated every six months. The Owner has records of when the gate was opened and the length of time that it was open. When the gate is operated, the oil level in the gate stem casing is checked and, if necessary, brought up to full.

4.4 Warning Systems in Effect. There is no formal warning system established for Lake Choctaw Dam. During periods of heavy rainfall, the Project Engineer and the Assistant for Construction and Maintenance check the dam and inspect the spillway for debris. The Project Engineer said that if a problem were to develop, the slide gate would be opened at his direction.

4.5 Evaluation. The operational and maintenance procedures for the dam and outlet works appear to be satisfactory. The inspections of the dam and appurtenant structures are too informal, they are not conducted frequently enough and records of the inspections are not kept. The warning system is inadequate.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features.

a. Design Data.

(1) No detailed hydrologic or hydraulic analyses for the Lake Choctaw Dam design were reviewed. The permit application report prepared by PennDER indicated that the capacity of the spillway was sufficient to pass the Curve "C" discharge of 2,995 cfs.

(2) In the recommended guidelines for safety inspection of dam, the Department of the Army, Office of the Chief of Engineers (OCE) established criteria for rating the capacity of spillways. The recommended spillway design flood for the size (small) and hazard potential (high) classification of Lake Choctaw Dam is from one-half the Probable Maximum Flood (PMF) to the PMF. Because the height of Lake Choctaw Dam is in the middle of the height range for classification as a small dam (25-40 feet), and because intensive development of the downstream area is planned, the recommended spillway design flood for Lake Choctaw Dam is the PMF. If the dam and spillway are not capable of passing the PMF without overtopping failure, the spillway capacity is rated as inadequate. If the dam and spillway are capable of passing one-half of the PMF without overtopping failure, the spillway capacity is not rated as seriously inadequate. A spillway capacity is rated as seriously inadequate if all of the following conditions exist:

(a) There is a high hazard to loss of life from large flows downstream of the dam.

(b) Dam failure resulting from overtopping would significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure.

(c) The dam and spillway are not capable of passing one-half of the PMF without overtopping failure.

(3) The Lake Choctaw watershed is completely owned by High Vista, Inc. Large portions of this area are currently undeveloped, but it is the intent of the owner to sell the land for building lots. The sales agreement for each parcel limits tree and shrub removal to that which is necessary to construct the house and driveway. It is expected that the planned development of the Lake Choctaw watershed will not substantially alter the character of runoff. Therefore, the hydrologic analysis for this study was based on existing conditions and the effects of future development were not considered. Another small dam that does not impound any water, Lake Calument Dam, is located a short distance upstream from Lake Susquehanna Dam. This dam is breached and has no significant effect on the hydrology of the watershed.

b. Experience Data. For this study, the PMF was obtained from the curve of PMF peak flow versus drainage area for Region 2 of the Susquehanna River Basin.(1) The calculated PMF was transposed to the Lake Susquehanna watershed, which is 0.4 mile upstream of Lake Choctaw, to determine the effects of such a storm on both dams. The locations of the dams are shown on Plate 1. The PMF peak flow for Lake Choctaw is 6,580 cfs. The Lake Susquehanna component of the Lake Choctaw PMF has a peak of 4,350 cfs. The PMF for Lake Susquehanna alone is 5,080 cfs. Hydrologic computations are presented in Appendix C.

c. Visual Observations. On the date of the inspection no conditions were observed that indicated that the spillway capacity would be significantly reduced during a flood occurrence.

d. Overtopping Potential. Two cases were analyzed to check the overtopping potential of Lake Choctaw Dam. Case 1 evaluated the effects of a storm over the entire Lake Choctaw Dam watershed, which includes the Lake Susquehanna Dam watershed. Case 2 evaluated the effects of a storm over the Lake Susquehanna Dam watershed along.

(1) For Case 1, the peak inflow of the Susquehanna component of the Lake Choctaw Dam PMF is 4,350 cfs. This is greater than the Lake Susquehanna Dam spillway capacity of 2,290 cfs. A check of the

---

(1) Obtained from the Baltimore District, Corps of Engineers.

surcharge storage effect of Lake Susquehanna indicated that the spillway capacity of 2,290 cfs and the surcharge storage available are insufficient to contain an inflow of 4,350 cfs without overtopping the dam (Appendix C). Overtopping of Lake Susquehanna Dam would probably result in failure of the dam. The peak flow that would result from failure of Lake Susquehanna Dam was estimated to be about 90,000 cfs (Appendix C). If Lake Susquehanna Dam should fail due to overtopping, the spillway capacity and surcharge storage available for Lake Choctaw are insufficient to contain an inflow of 90,000 cfs without overtopping the dam (Appendix C). Overtopping of Lake Choctaw Dam would probably result in failure of the dam.

(2) For Case 2, the peak inflow of the PMF for the Lake Susquehanna Dam watershed alone is 5,080 cfs. Since this is a greater inflow than was determined for Case 1, the end result for Case 2 is the same as that for Case 1. Lake Susquehanna Dam would be overtopped and probably fail. Failure of Lake Susquehanna Dam would cause overtopping and probable failure of Lake Choctaw Dam.

e. Downstream Conditions. As shown on Plate 1, Lake Choctaw Dam is on Little Sugarloaf Creek in North Union Township, Schuylkill County. High Vista, Inc. plans to construct another dam, Lake Algonquin Dam, downstream from Lake Choctaw Dam. This area is to be developed by High Vista, Inc. and will complete their Valley of Lakes project. The planned development will be similar to the areas around Lake Susquehanna and Lake Choctaw. About 1.3 miles downstream from Lake Choctaw Dam, is the confluence of Little Sugarloaf Creek with Tomhicken Creek. There are a few low-lying houses 0.7 mile downstream from this confluence. Tomhicken Creek flows through a deeply incised valley that is a mixture of agricultural land and woodland with a few scattered low-lying houses for the next 2.9 miles. The downstream conditions indicate that a high hazard classification is warranted for Lake Choctaw Dam.

f. Spillway Adequacy.

(1) For Case 1, an occurrence of the PMF over the entire Lake Choctaw watershed would cause overtopping and probable failure of Lake Choctaw Dam. Therefore, based on OCE criteria as outlined in Paragraph 5.1 a.(2), the spillway is rated as inadequate. One-half the PMF for Case 1 is 2,850 cfs,

which includes the peak attenuation effect of Lake Susquehanna. Considering the effect of the combined surcharge storage available in Lake Susquehanna and Lake Choctaw, which is 336 acre-feet, the Lake Choctaw Dam spillway can accommodate a flood with a peak inflow of 2,810 cfs for a storm of the same duration as the PMF. This is 47 percent of the PMF for the entire Lake Choctaw Dam water shed. Therefore, based on OCE criteria, the spillway of Lake Choctaw Dam is rated as seriously inadequate for Case 1.

(2) For Case 2, the Lake Susquehanna Dam spillway will not pass its PMF without overtopping failure, and the Lake Choctaw Dam spillway cannot pass the resulting failure hydrograph without overtopping failure of Lake Choctaw Dam. Therefore, based on OCE criteria as outlined in Paragraph 5.1 a.(2), the spillway is rated as inadequate. One-half the PMF for Case 2 is 2,540 cfs, which will pass the Lake Susquehanna Dam spillway without overtopping the dam. This is also less than the Lake Choctaw spillway capacity. Therefore, based on OCE criteria, the spillway capacity of Lake Choctaw Dam is not rated as seriously inadequate for Case 2.

(3) The maximum tailwater is estimated to be Elevation 1106 at the spillway capacity of 2,560 cfs. At maximum pool elevation, there is a difference of 30 feet between headwater and tailwater. If Lake Choctaw Dam should fail due to overtopping, the hazard to loss of life will be significantly increased from that which would exist just prior to overtopping.

(4) As shown in the preceding paragraphs, the spillway of Lake Choctaw Dam is rated as seriously inadequate for Case 1 and inadequate for Case 2. Because Case 1 is the critical case, the overall rating of the spillway is seriously inadequate. However, if the low areas of the top of the embankment were brought up to design grade, which would be a relatively minor maintenance task, the spillway capacity would be increased to 3,350 cfs. This would permit the accommodation of a flood with a peak inflow of 4,030 cfs, or 61 percent of the Lake Choctaw PMF peak flow. The spillway capacity of Lake Choctaw Dam would then be rated as inadequate instead of seriously inadequate.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations.

(1) General. The visual inspection of Lake Choctaw Dam resulted in a number of observations relevant to structural stability. These observations are listed herein for the various features.

(2) Embankment. Surveys made during this inspection indicated that the downstream slope of the embankment might be steeper than the design slope. The detailed description and evaluation of the condition are in Paragraphs 3.1 b. (2) and 3.2 a. (2), respectively. Also, two wet areas were located along the downstream toe of the embankment. The detailed descriptions of the wet areas are in Paragraphs 3.1 b. (5) and 3.1 b. (6), and the evaluation of them is in Paragraph 3.2 a. (5).

b. Design and Construction Data. The stability computations for the embankment were not reviewed. However, the factors of safety for the embankment design are reported in the soils investigation report that was prepared by Northeastern Engineering Company and also in the permit application report prepared by PennDER. The factors of safety for the various design conditions are as follows:

Condition	Computed Factor of Safety	Required Factor of Safety
As constructed	1.53	1.3
Steady seepage	1.53	1.5
Rapid Drawdown	1.45	1.25

In each case the computed factor of safety for the embankment design is greater than the required factor of safety. In addition, the report by Northeastern indicates that the actual shear strength of the embankment materials is higher than the design shear strength. Consequently, the computed factors of

safety are somewhat lower than the actual factors of safety. This aspect of the design should offset the decrease in the factors of safety caused by having the downstream slope steeper than design. Northeast Engineering Company also advised that any springs under the embankment would have to be properly intercepted by drains in order to maintain the stability of the embankment. Available construction data did not indicate that any problems of this nature were encountered.

c. Operating Records. There is no evidence that any stability problems have occurred for the dam or the spillway since the dam was completed in 1974. The excellent condition of the spillway structures indicates that they have performed as intended.

d. Post-Construction Changes. There have been no known modifications to the dam or the appurtenant structures.

e. Seismic Stability. This dam is located in Seismic Zone 1. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety.

(1) Based on the visual inspection, available records, calculations and past operational performance, Lake Choctaw Dam is judged to be in good condition. However, deficiencies of varying degree of importance were noted. A summary of the features and observed deficiencies is listed below:

Feature and Location	Observed Deficiencies
Embankment:	
Top of embankment	Low areas; lack of vegetation.
Upstream slope	Damaged area near spillway; light growth of brush.
Downstream slope	Incomplete cover of vegetation; slopes steeper than design.
Downstream toe	Two wet areas.
Spillway:	
Concrete Surfaces	Heavy algae growth.
Reservoir Area:	Inflow of acid mine drainage.

(2) The overtopping potential analysis considered two cases. The first case evaluated the effects of a storm over the entire Lake Choctaw watershed and included analysis of the effects of Lake Susquehanna Dam, which is located 0.4 mile upstream. The second case evaluated the effects of a storm over the Lake Susquehanna watershed alone. The

analyses showed that the first case is the critical case, and for a storm over the entire Lake Choctaw watershed the Lake Choctaw Dam spillway is rated as seriously inadequate. The existing spillway can accommodate a flood with a peak flow of 2,810 cfs, which is 47 percent of the PMF peak inflow for the Lake Choctaw watershed. If the low areas on the embankment were brought up to design grade, the existing spillway could accomodate a flood with a peak flow of 4,030 cfs, which is 61 percent of the PMF peak inflow for the entire Lake Choctaw watershed. The existing spillway would then be rated as inadequate instead of seriously inadequate.

(3) Review of available data concerning stability of the embankment and the visual inspection of the dam indicate that the downstream slope of the dam is steeper than the design slope. The extent of this deviation from design should be more accurately determined, and the effects on stability should be investigated. Because it is reported that the design shear strength is less than the actual shear strength, a serious problem is not anticipated.

b. Adequacy of Information. The information available is such that an assessment of the condition of the dam can be inferred from the combination of visual inspection, past performance, and computations performed prior to and as part of this study.

c. Urgency. The recommendations in Paragraph 7.2 should be implemented immediately or in a timely manner, as noted.

d. Necessity for Further Investigations. In order to accomplish some of the remedial measures outlined in Paragraph 7.2, further investigations will be required.

7.2 Recommendations and Remedial Measures.

a. In view of the concern for safety of Lake Choctaw Dam, the following measures are recommended to be undertaken by the Owner immediately:

(1) Perform surveys to establish the extent of the low areas on the embankment and fill in the areas to design grade.

(2) Develop a detailed emergency operation and warning system for Lake Choctaw Dam.

b. In order to correct operational, maintenance and repair deficiencies, and to more accurately determine the condition of the dam, the following measures are recommended to be undertaken by the Owner in a timely manner:

(1) Repair area on upstream slope of embankment near spillway.

(2) Perform additional surveys as necessary to accurately determine the downstream slope of the embankment and evaluate the effects on the factor of safety for stability.

(3) Remove brush growing among riprap on upstream slope.

(4) Until good vegetal cover is established on the downstream slope, the Owner should monitor the condition of the embankment and promptly fill any erosion gullies that might develop.

(5) Visually monitor the two wet areas along the downstream toe of the dam. The outflow should be estimated and records should be kept so that any change in condition is apparent.

(6) Have water samples analyzed to determine the quality of the water and evaluate the susceptibility of the concrete to chemical attack. If necessary, undertake remedial measures to protect the concrete surfaces. The algae should periodically be removed to examine the concrete for symptoms of attack.

c. In addition, the following operational measures are recommended to be undertaken by the Owner:

(1) Provide round-the-clock surveillance of Lake Choctaw Dam during periods of unusually heavy rains.

(2) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system procedures.

(3) Implement an annual inspection program of all project features and maintain inspection records.

SUSQUEHANNA RIVER BASIN

LITTLE SUGARLOAF CREEK, SCHUYLKILL COUNTY

PENNSYLVANIA

LAKE CHOCTAW DAM

NDS ID No. PA-00819
DER ID No. 54-178

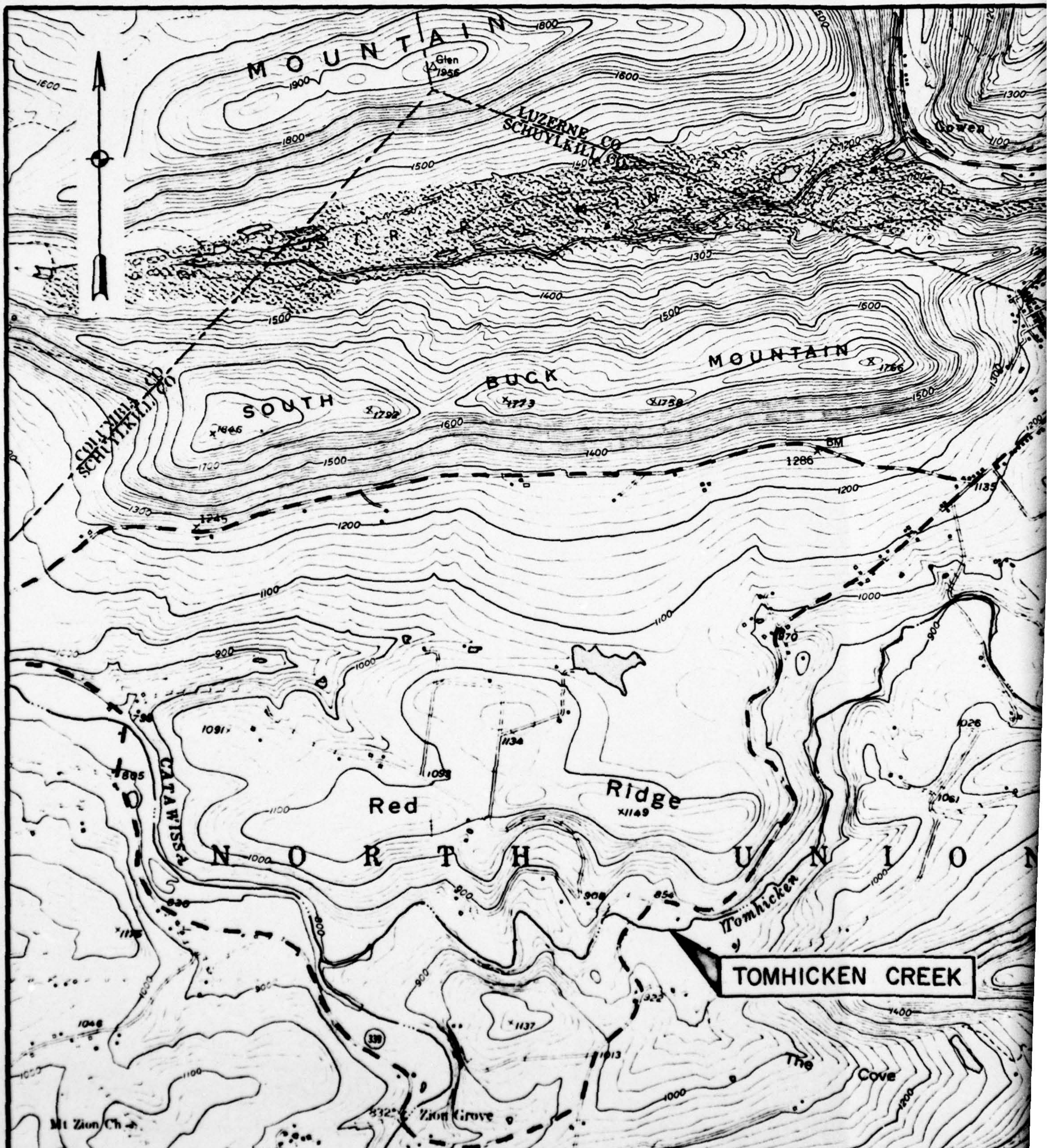
HIGH VISTA, INC.

PHASE I INSPECTION REPORT

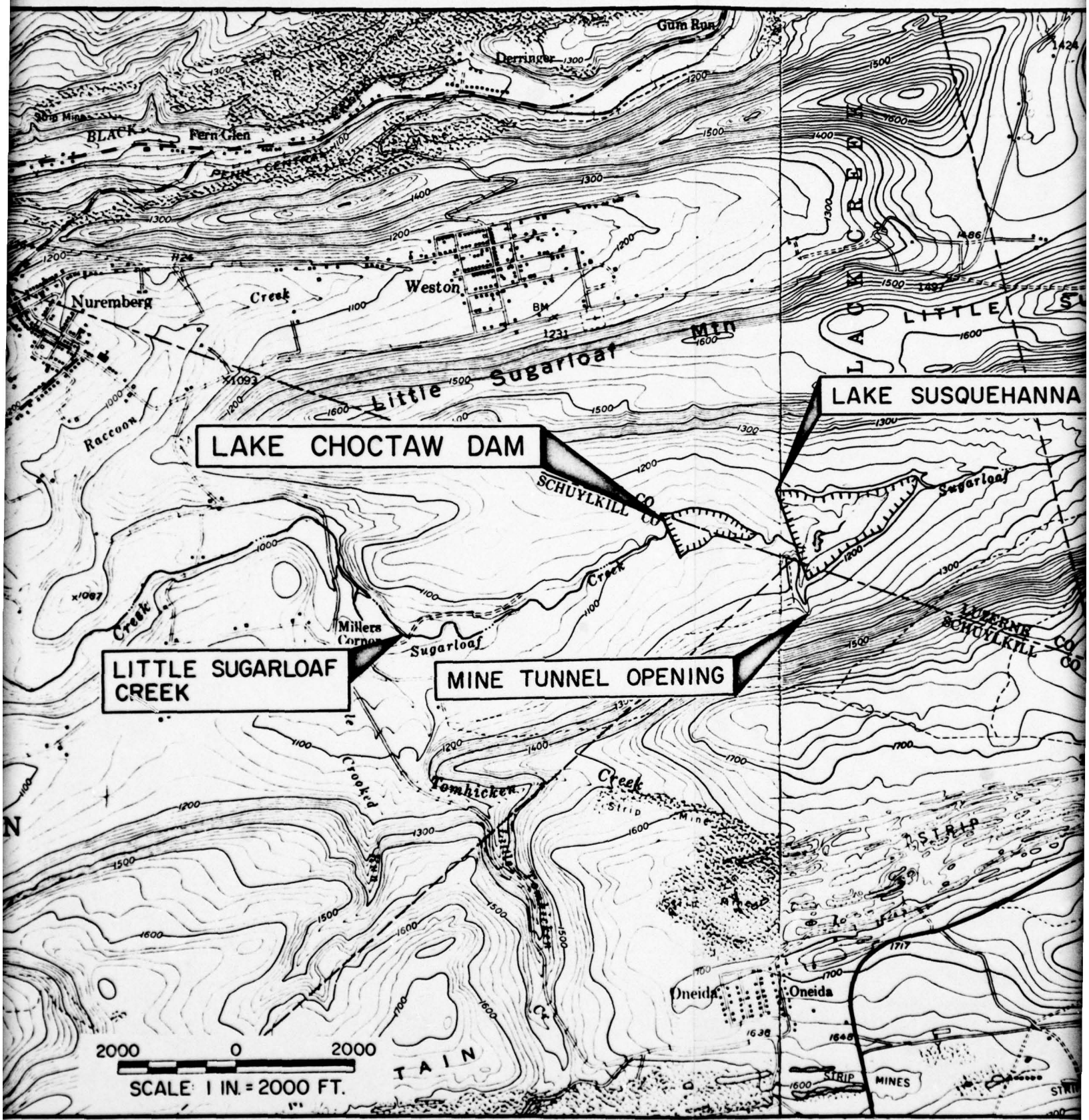
NATIONAL DAM INSPECTION PROGRAM

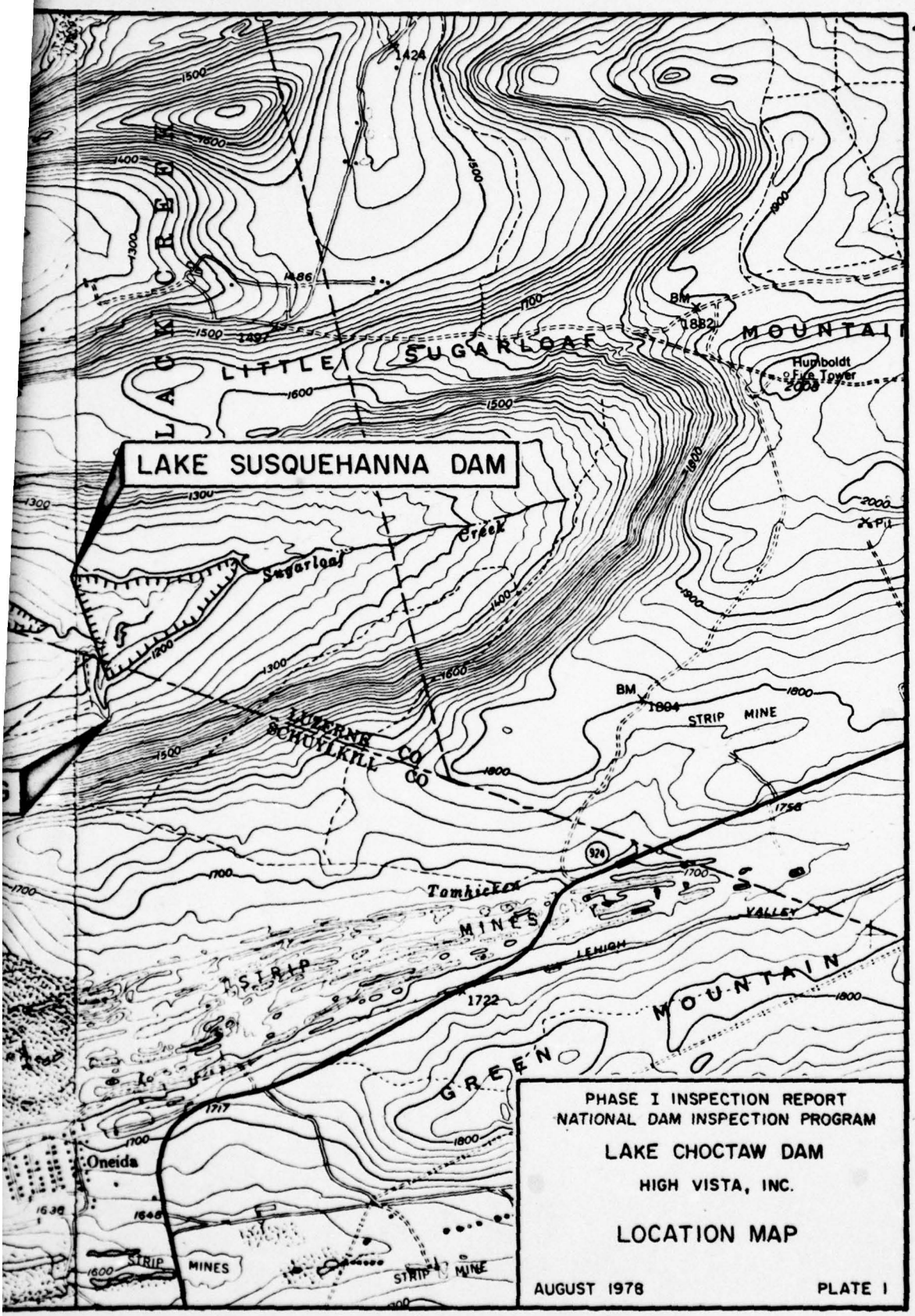
AUGUST 1978

PLATES


MOUNTAIN
LUZERNE CO
SCHUYLKILL CO
SOUTH BUCK MOUNTAIN
COLUMBIA CO
SCHUYLKILL CO
Red Ridge
CATAWISSA
NORTH UNION
Tomhicken
TOMHICKEN CREEK
The Cove
Zion Grove
Mt Zion Ch
Cowen

2


LAKE CHOCTAW DAM
LAKE SUSQUEHANNA
LITTLE SUGARLOAF CREEK
MINE TUNNEL OPENING
Gum Run
Derringer
Strip Mine
BLACK
Fern Glen
PENN CENTRAL
Nuremberg
Creek
Weston
BM
1231
Little Sugarloaf
Min
Raccoon
Creek
SCHUYLKILL CO
Sugarloaf
Creek
Millers Corner
Sugarloaf
Crooked
Tomhicken
Creek
Strip Mine
Oneida
Oneida
STRIP MINES
2000 0 2000
SCALE 1 IN. = 2000 FT.



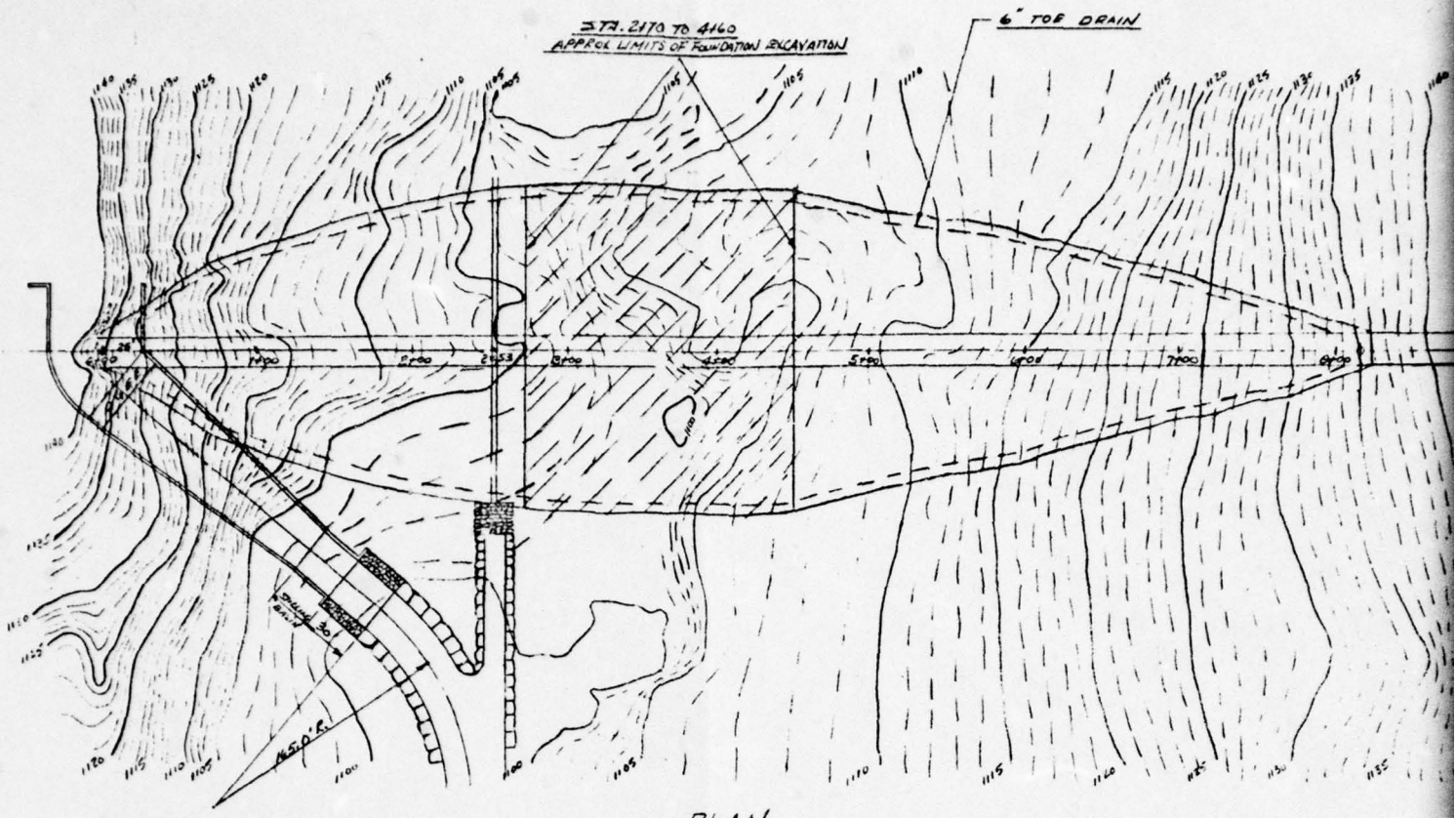
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE CHOCTAW DAM

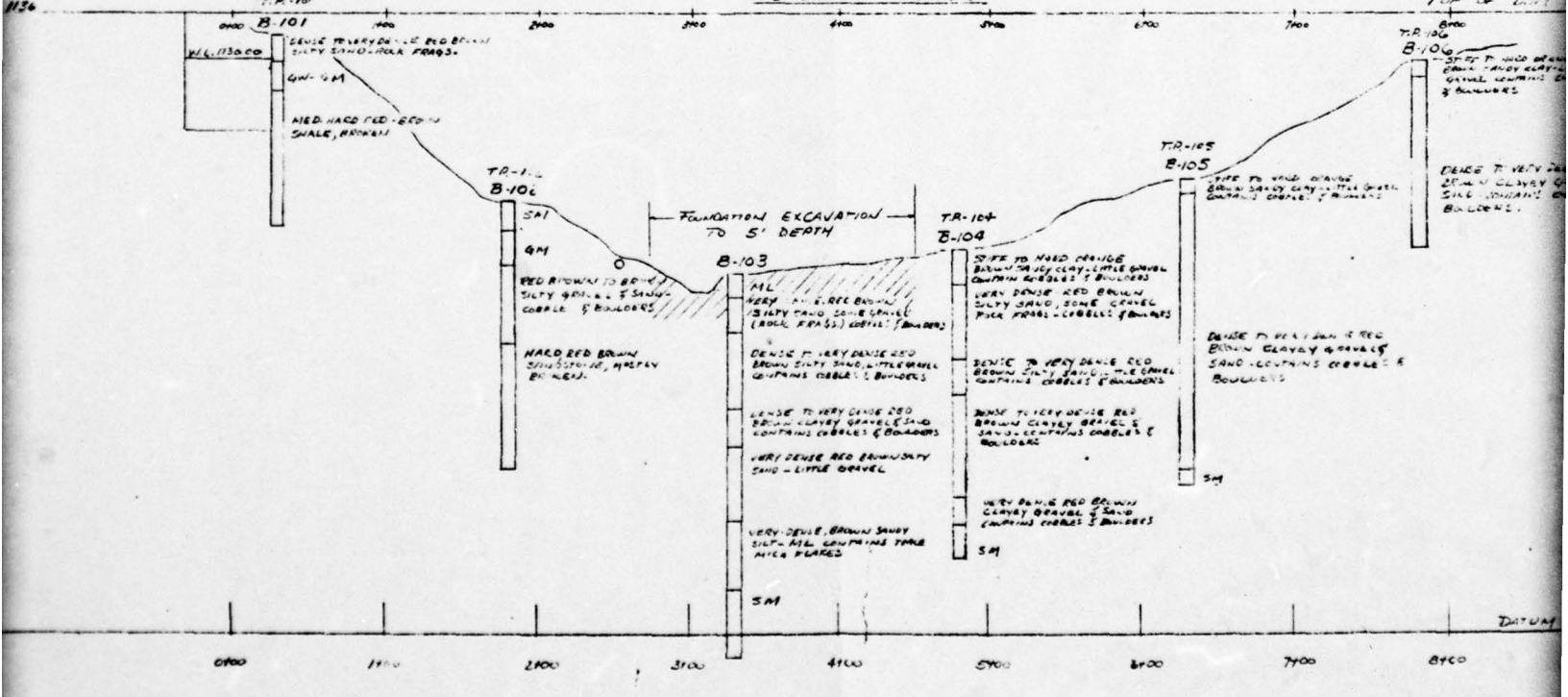
HIGH VISTA, INC.

LOCATION MAP

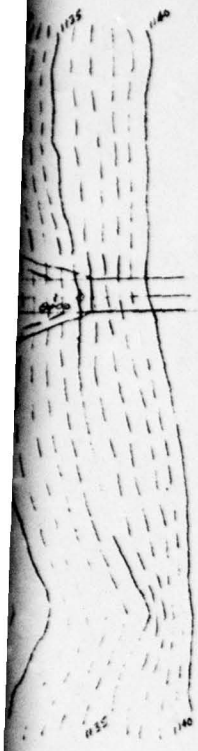
AUGUST 1978 PLATE 1

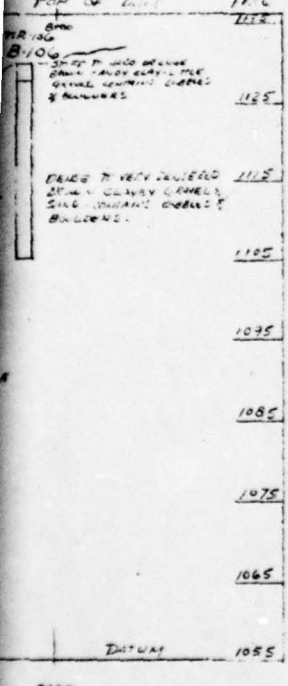


PLAN
SCALE: 1" = 50
5' CONTOUR INTERVALS



SECTION A-A (SHEET 1 OF 15)
SCALE: VERT. 1" = 5' HOR. 1" = 50'





NOTE:
ALL DIMENSIONS AND ALIGNMENT SHALL BE CHECKED AND VERIFIED BY CONTRACTOR AT THE SITE.

BORING RESULTS NOTED AS PER LOGS FURNISHED BY SPRAGUE & HENWOOD INC.

SEE SOIL INVESTIGATION REPORT FOR ADDITIONAL INFORMATION.

OVER EXCAVATE AS REQUIRED (MIN. 2 DEPTH) IN AREA OF TP 103 - SEE SOIL INVESTIGATION REPORT.

DEPTH OF BOTTOM OF CUT-OFF TRENCH APPROX. 5'

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE CHOCTAW DAM

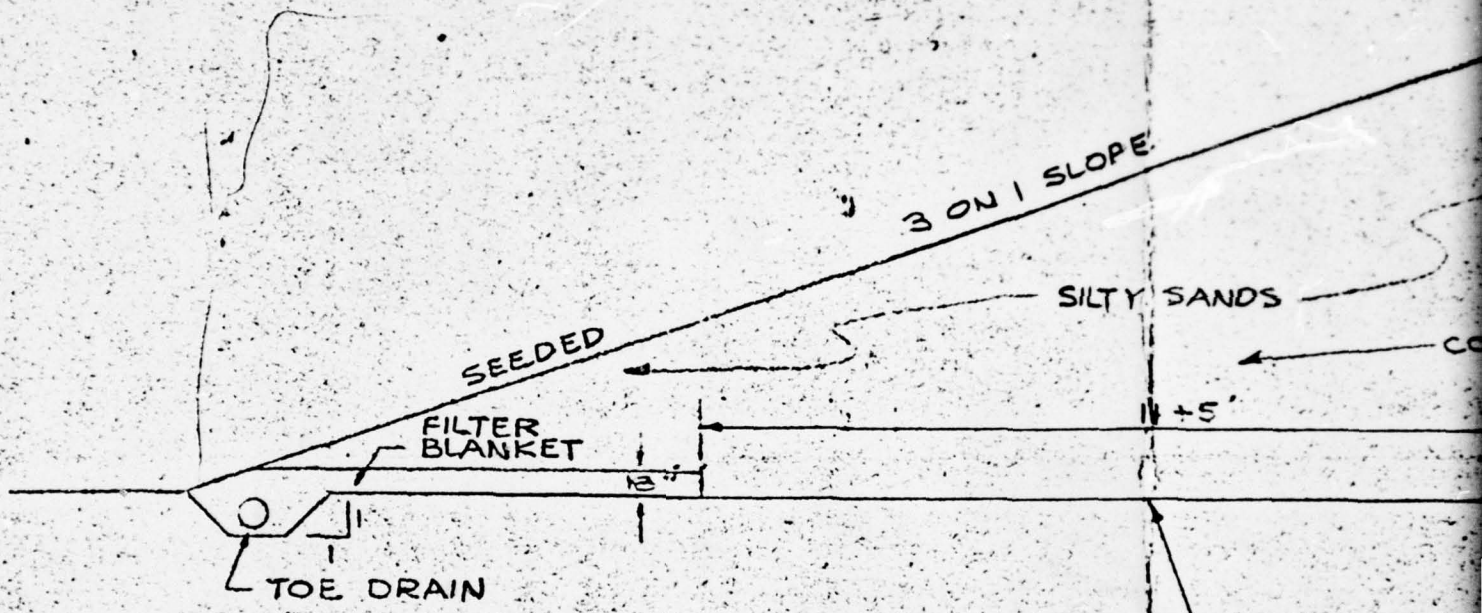
HIGH VISTA, INC.

PLAN AND PROFILE

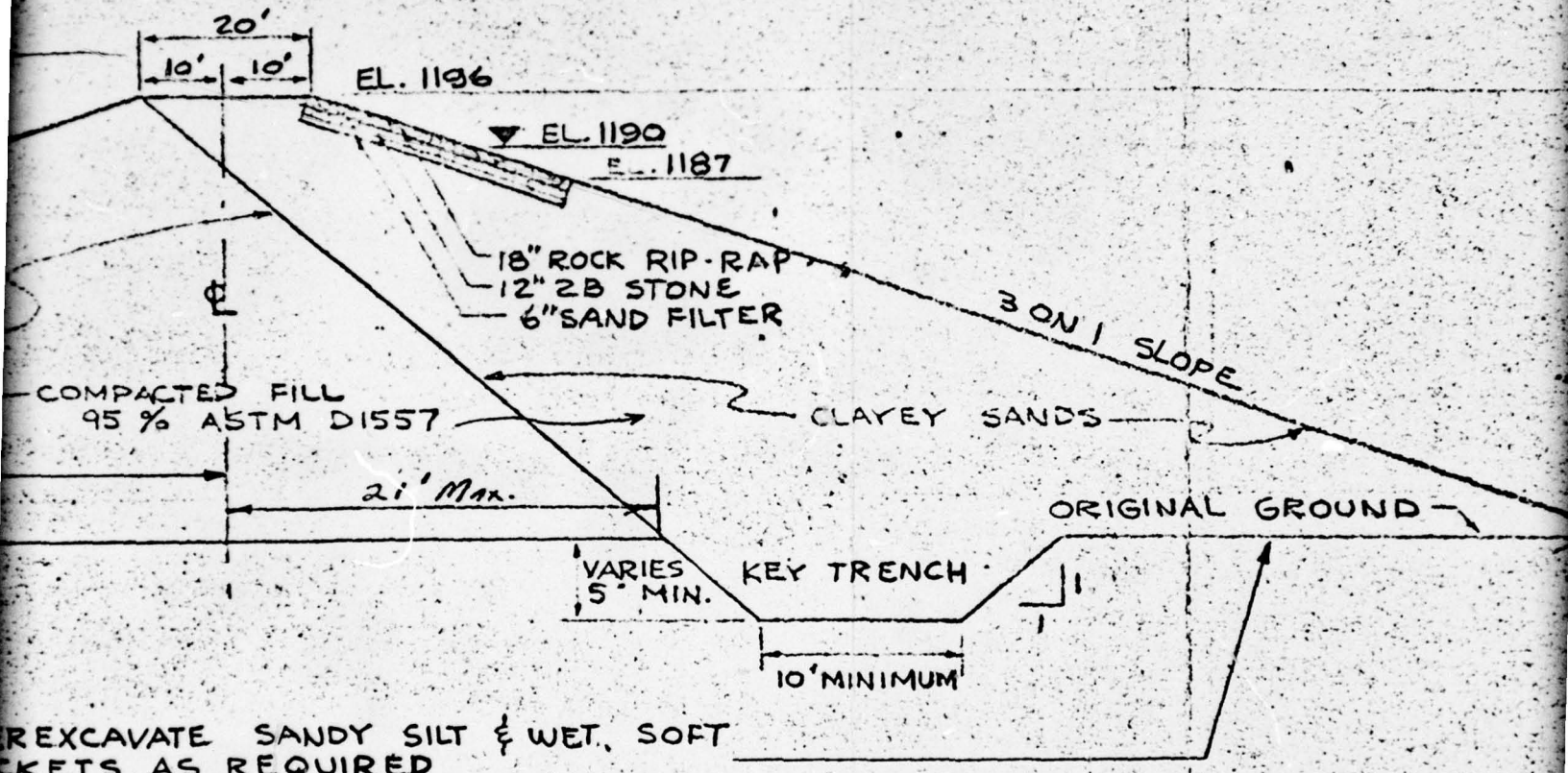
AUGUST 1978 PLATE 2

NOTED	EBECO ASSOCIATES, INC. CONSULTING ENGINEERS SURVEYORS - DESIGNERS - PLANNERS 110 W. CARLETON AVENUE HASLETON, PA. 18201	614
DRAWN BY H. SHAH		DRAWING NUMBER 1810

NOTE: PLACE AS MUCH CLAYEY SAND UPSTREAM AS IS POSSIBLE WHILE PLACING SILTY SAND DOWNSTREAM. AFTER EXPOSING THE CLAYEY SANDS BENEATH THE SILTY SANDS, USE ONLY CLAYEY SAND TO COMPLETE THE DAM

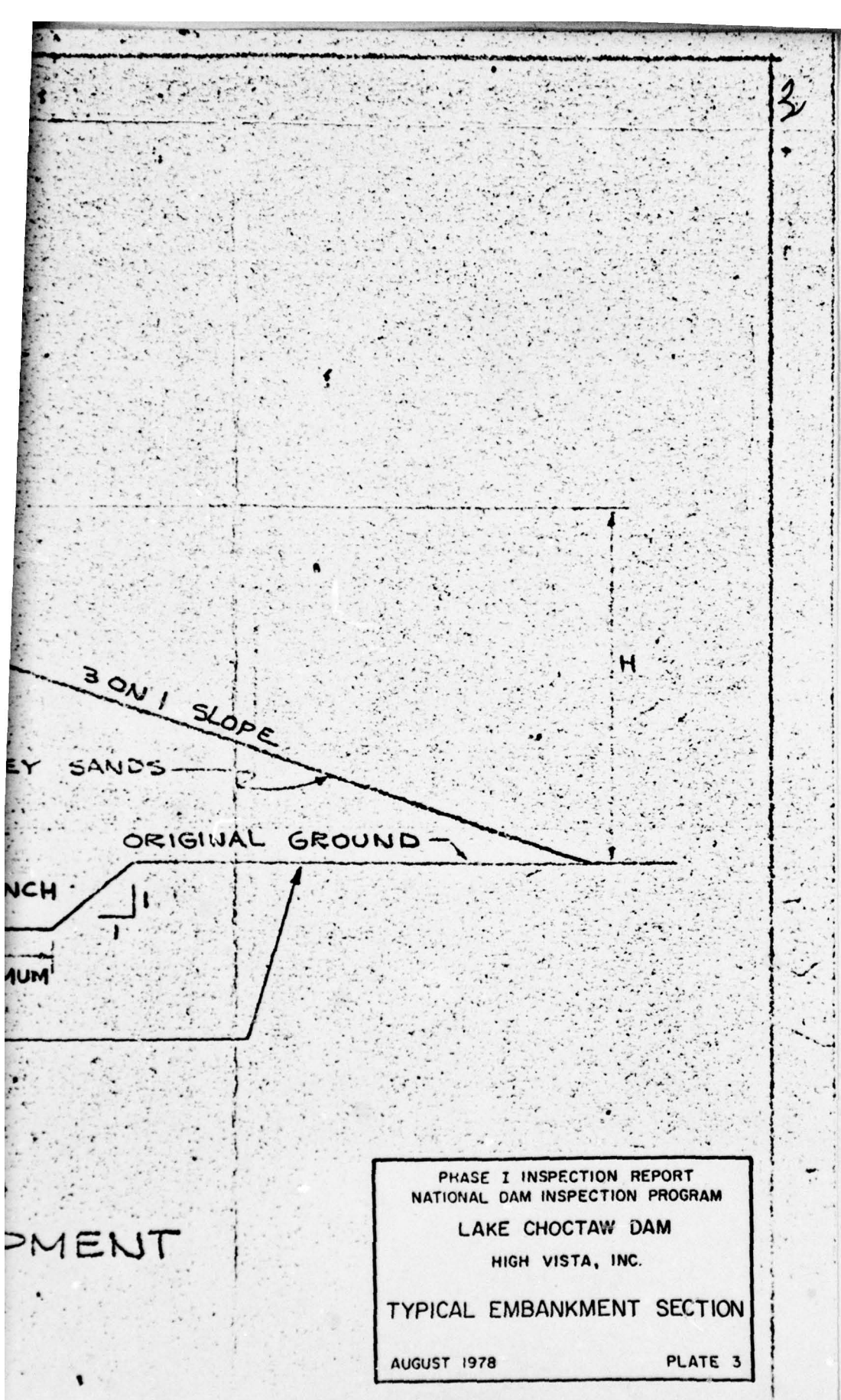


BIG VALLEY



TYPICAL SECTION
CHOCTAW DAM
EY RECREATIONAL DEVELOPMENT
SCALE: NOT TO SCALE

PHASE I
NATIONAL DAM
LAKE
HIGH
TYPICAL EME
AUGUST 1978



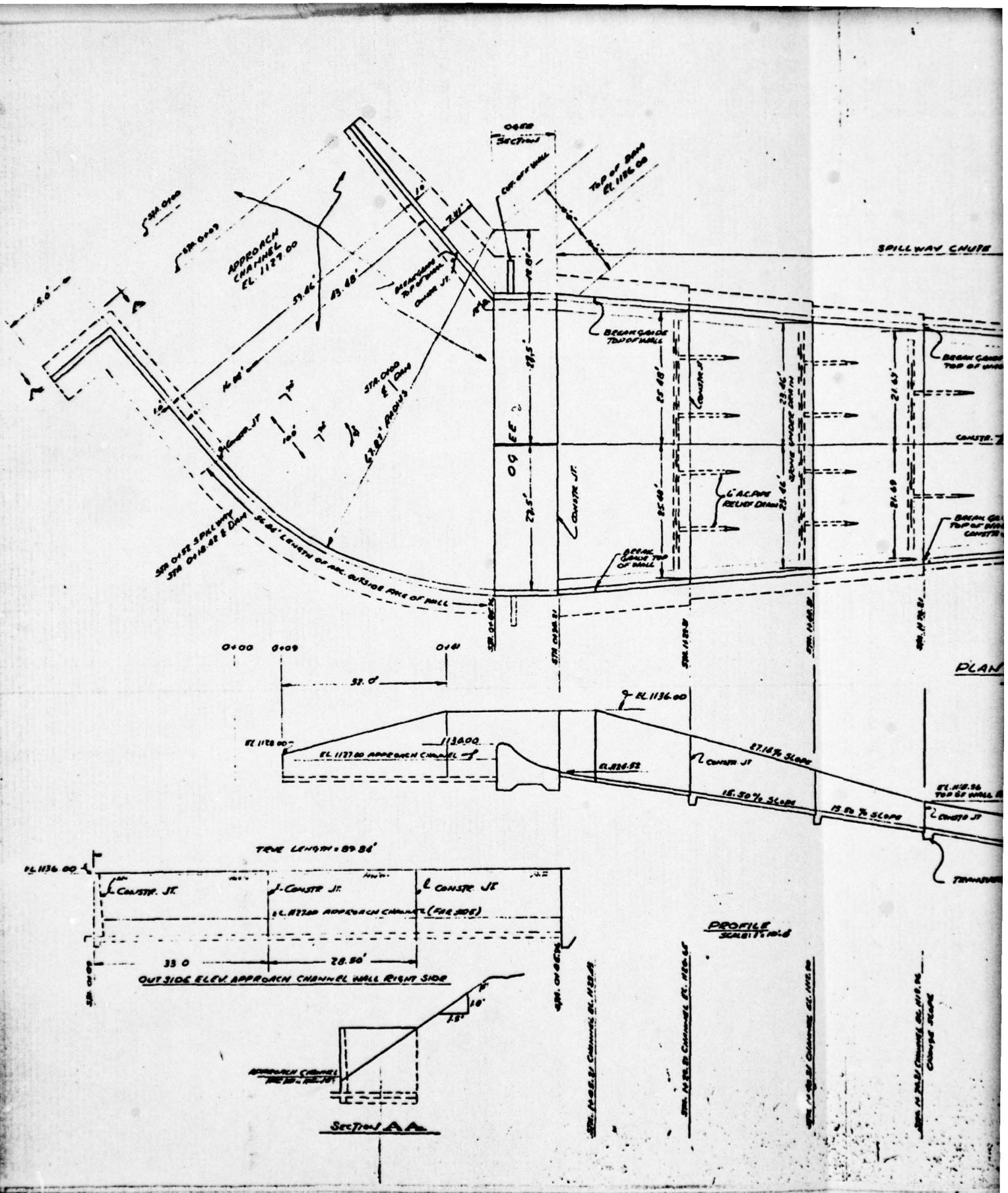
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

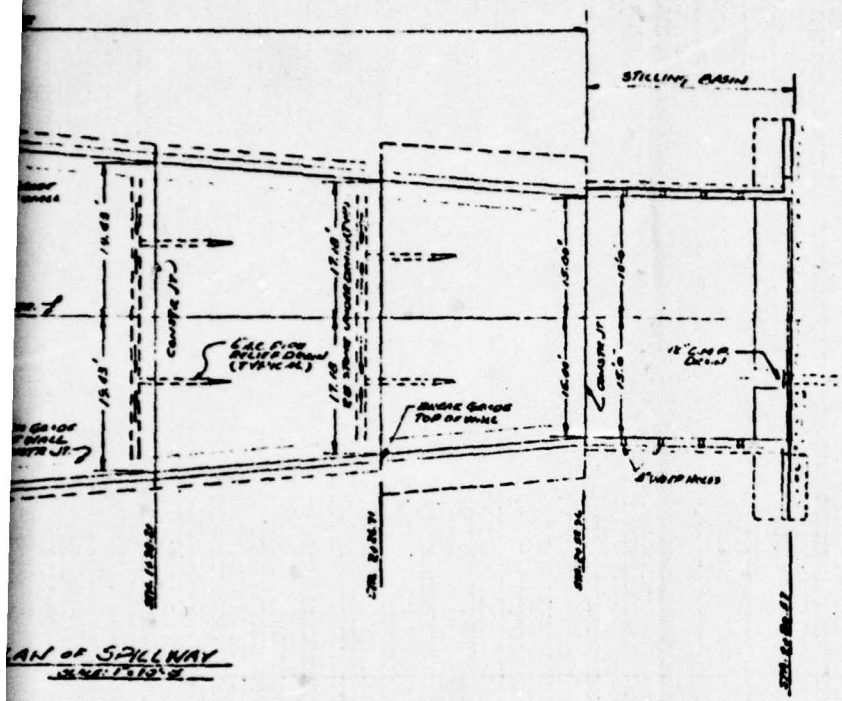
LAKE CHOCTAW DAM

HIGH VISTA, INC.

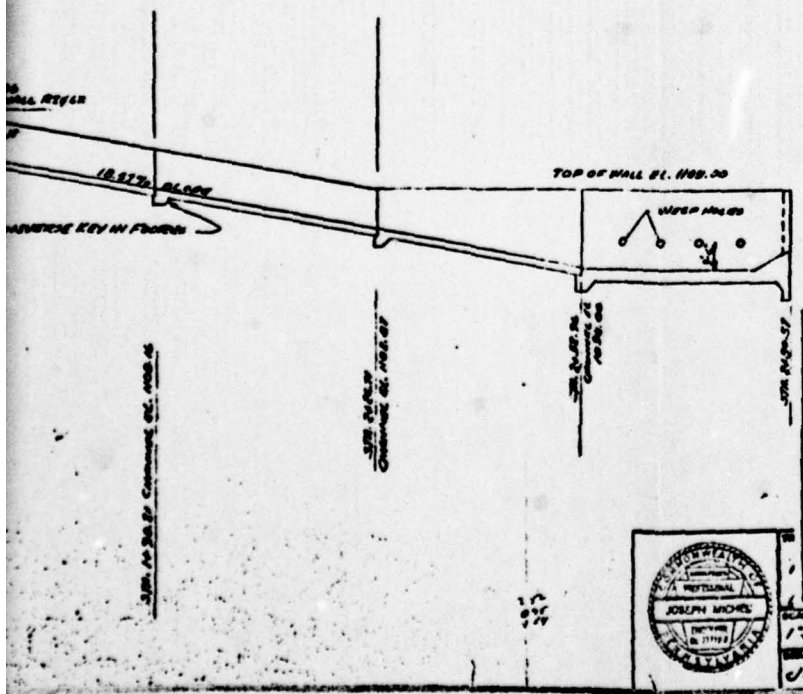
TYPICAL EMBANKMENT SECTION

AUGUST 1978 PLATE 3


SPILLWAY CHUTE
APPROACH CHANNEL EL. 1127.00
TOP OF DAM EL. 1136.00
CUT OFF WALL
BEGIN GRADE TOP OF WALL
CONSTR. JT.
6" A.C. PIPE RELIEF DRAINS
SPILLWAY 0+52
STA 0+18.48 ℄ DAM
56.84' LENGTH OF ARC OUTSIDE FACE OF WALL
PLAN
EL. 1136.00
EL. 1128.00
EL. 1127.00 APPROACH CHANNEL
EL. 1126.52
27.14% SLOPE
18.50% SLOPE
TRUE LENGTH = 89.84'
℄ CONSTR. JT.
℄ EL. 1127.00 APPROACH CHANNEL (RIGHT SIDE)
OUTSIDE ELEV. APPROACH CHANNEL WALL RIGHT SIDE
PROFILE
SCALE 1" = 10'-0"
Section AA



PLAN OF SPILLWAY



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

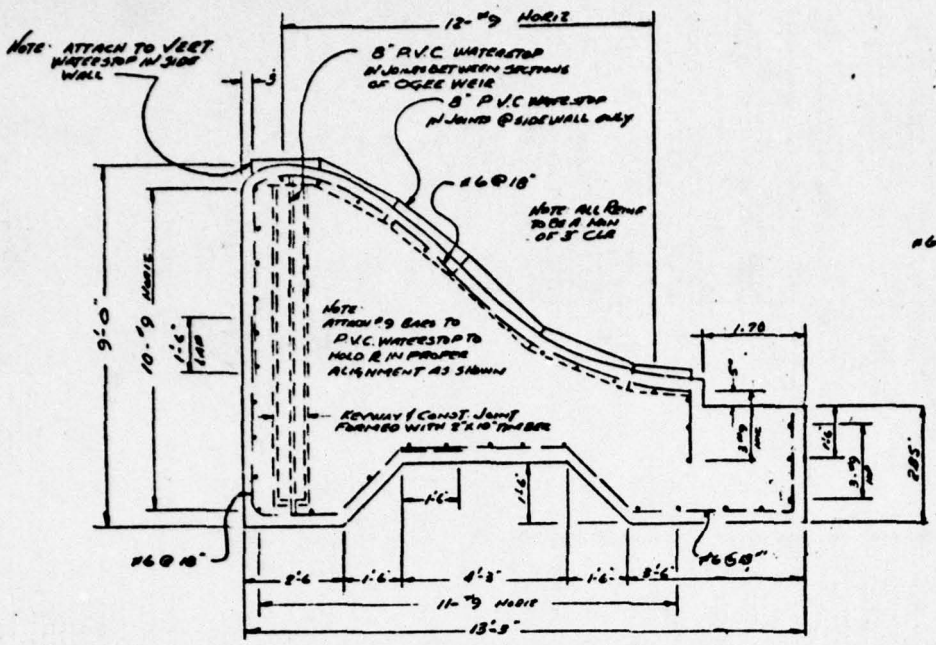
LAKE CHOCTAW DAM

HIGH VISTA, INC.

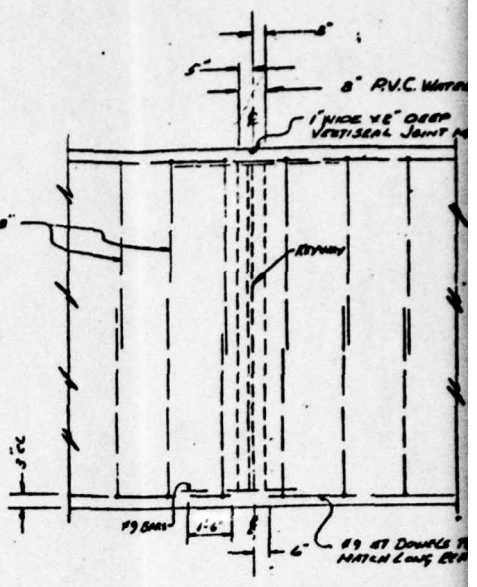
SPILLWAY PLAN AND PROFILE

AUGUST 1978 PLATE 4

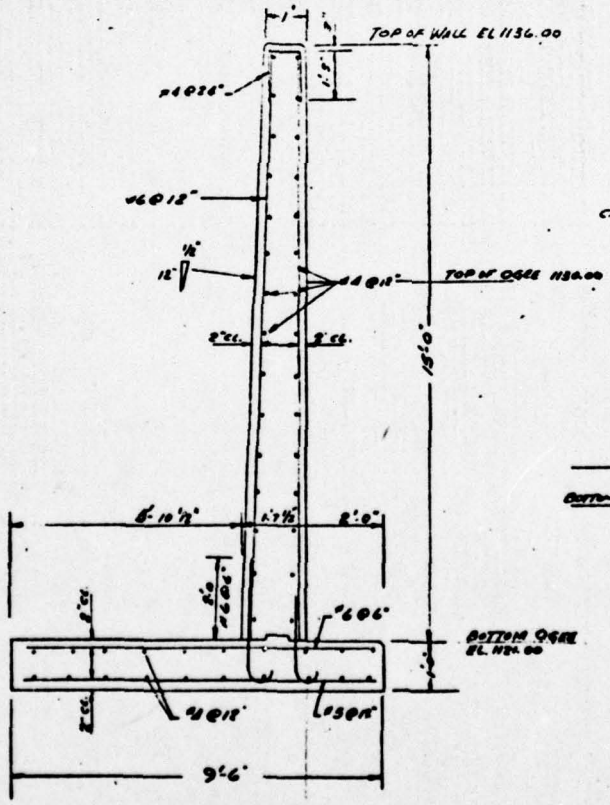
SCALE 1"=10'-0"	ESSCO ASSOCIATES, INC.	DATE 2-7-79	JOB NO. 618
DRAWN BY J PRICE			DRAWING NUMBER 1818



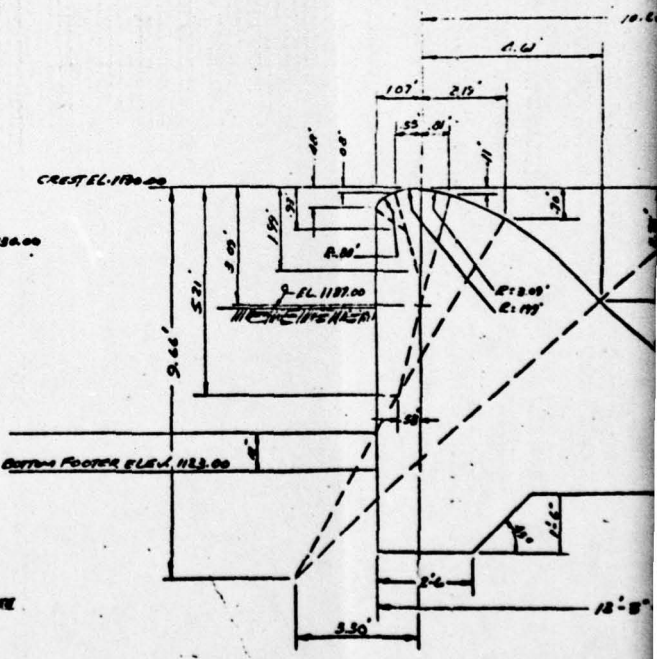
DETAIL - REINF. FOR OGEE SECTION
SCALE 1/2"=1'-0"



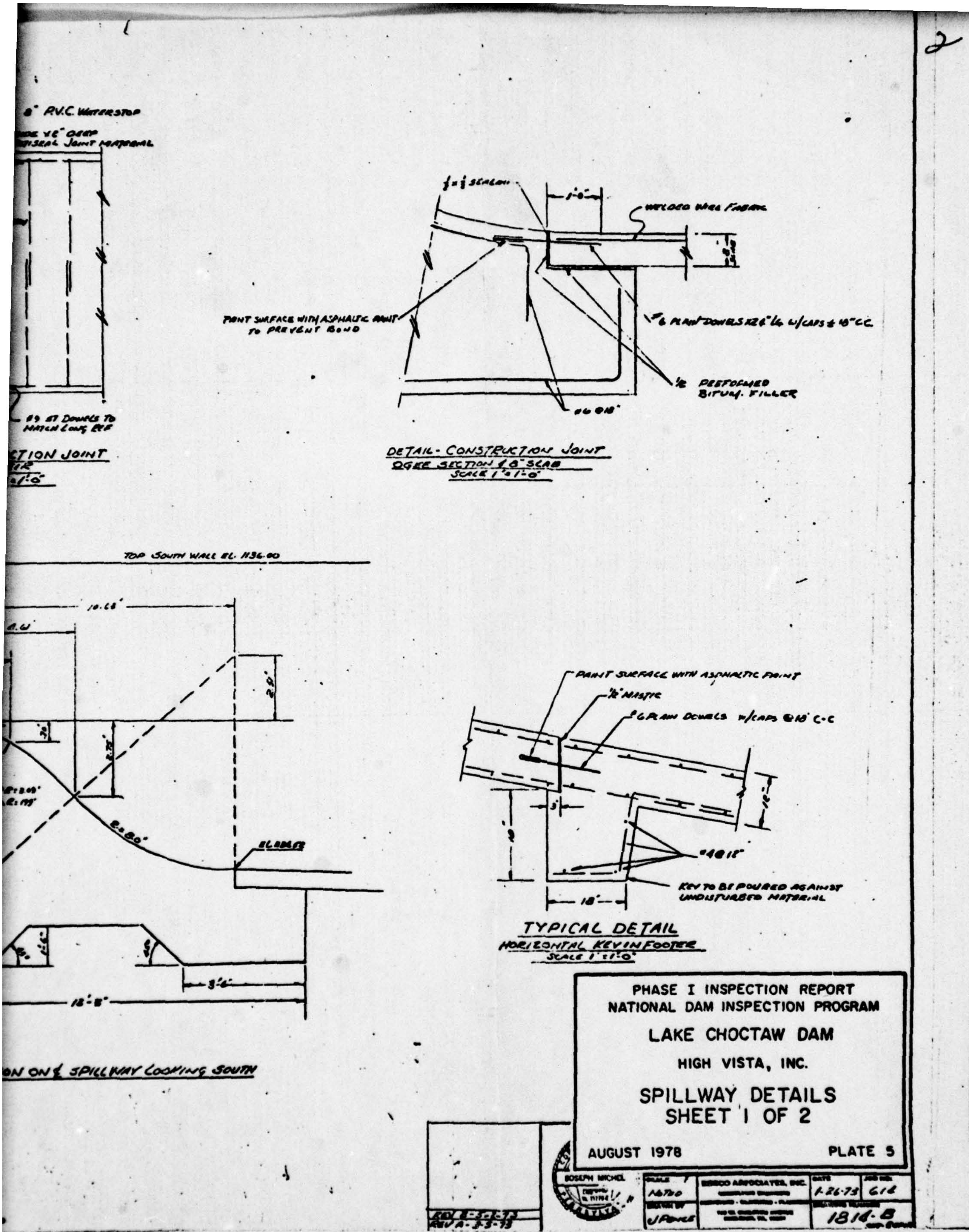
DETAIL - CONSTRUCTION JOINT
OGEE WEIR
SCALE = 1/2"=1'-0"



TYPICAL DETAIL
SPILLWAY WALL STA 0+85.96 TO STA. 0+96.71
SCALE: 3/8"=1'-0"



SECTION ON ℄ SPILL



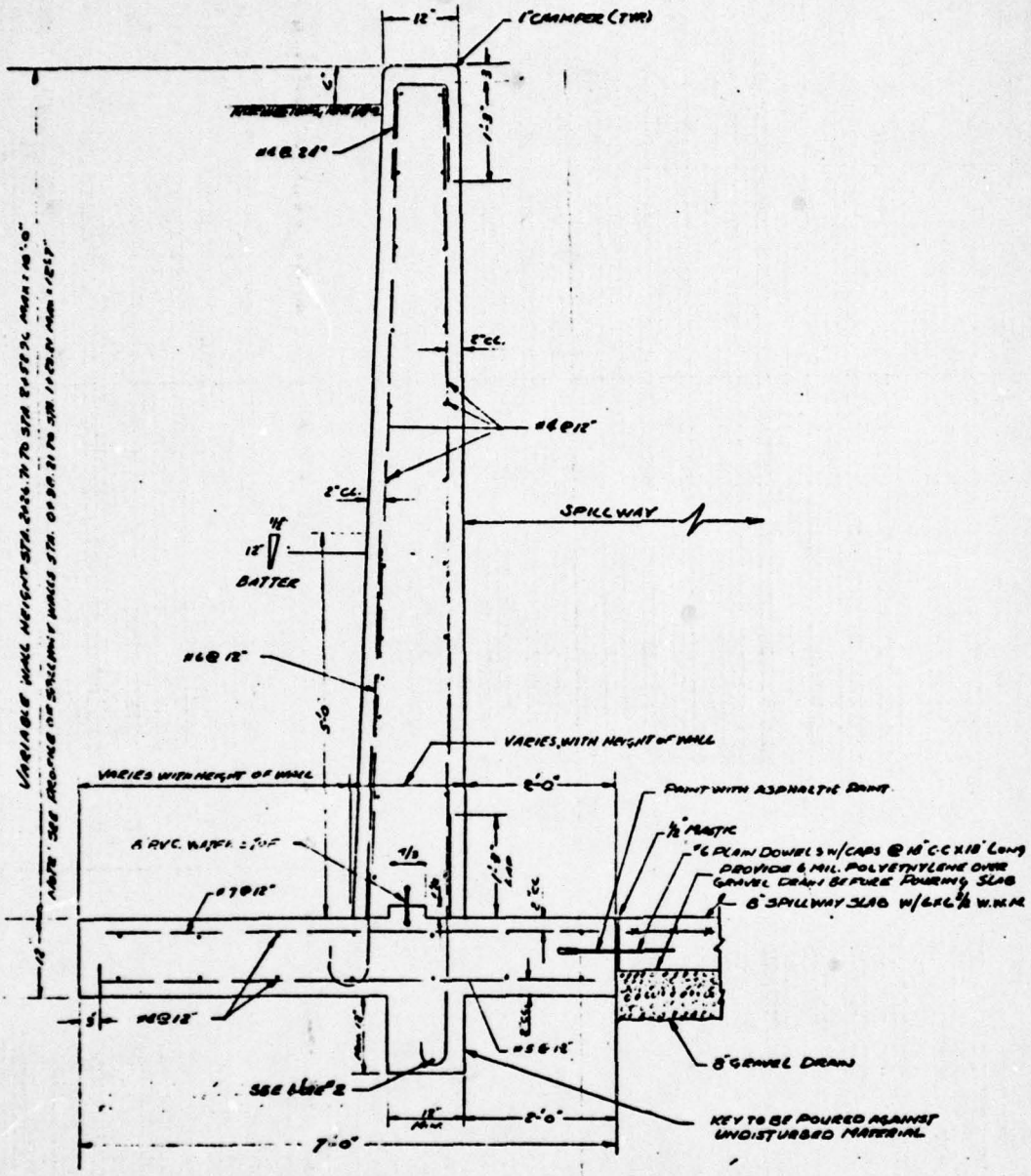
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE CHOCTAW DAM

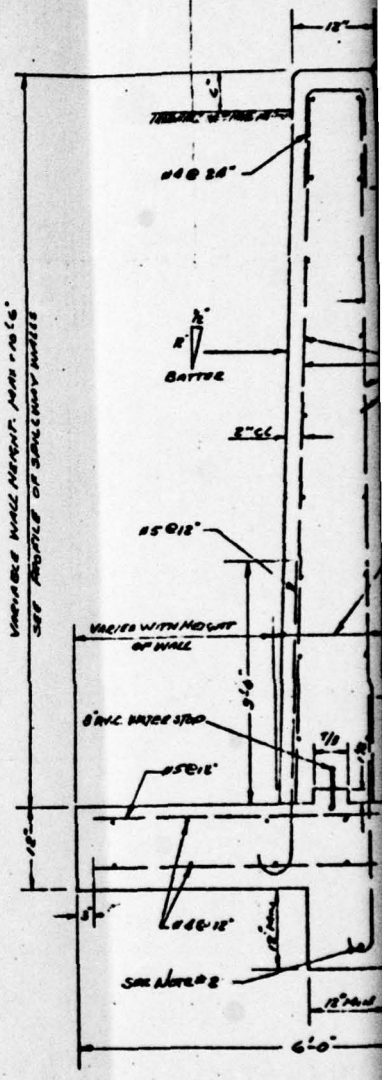
HIGH VISTA, INC.

SPILLWAY DETAILS
SHEET 1 OF 2

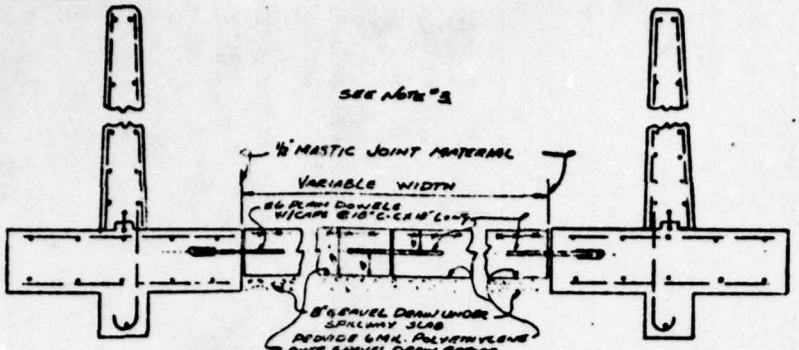
AUGUST 1978 PLATE 5



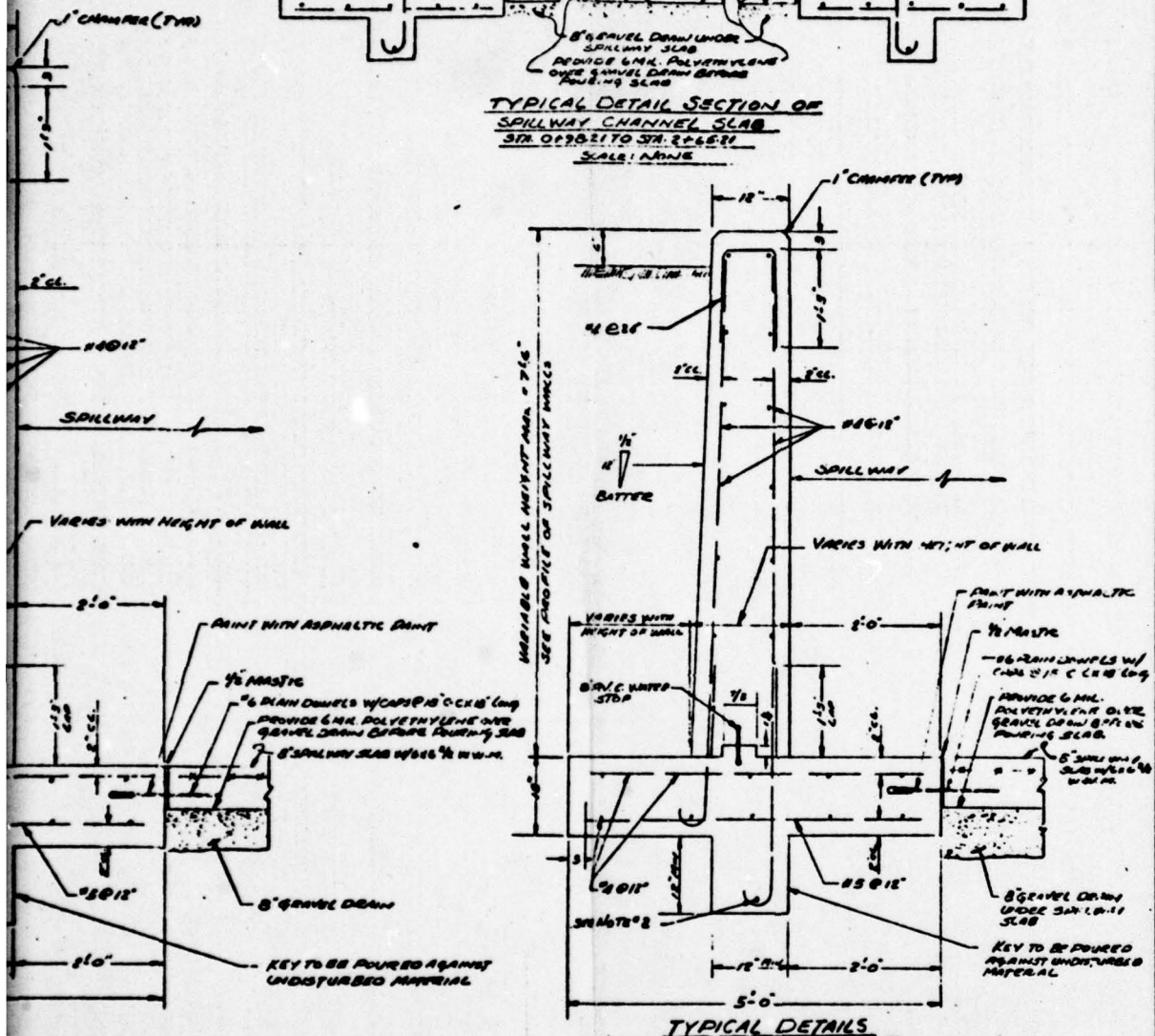
TYPICAL DETAIL
SPILLWAY WALLS LEFT & RIGHT
STA 0+98.21 TO STA 1+24.21
STA 2+26.71 TO STA. 2+52.96
SCALE 1"=1'-0"



TYPICAL DE
SPILLWAY WALLS
STA. 1+24.21 TO STA. 1+
SCALE 1"=1'-



TYPICAL DETAIL SECTION OF SPILLWAY CHANNEL SLAB
STA. 0+98.21 TO STA. 2+46.21
SCALE: NONE



TYPICAL DETAILS
SPILLWAY WALLS LEFT & RIGHT
STA. 1+85.21 TO 2+76.21
SCALE 1"=1'-0"

NOTES:
1- 8" GRAVEL DRAIN TO BE MIXTURE OF
50% TYPE A SAND
50% TYPE 2B STONE
2- PROVIDE #6@18" ANCHORS FOR VERT. #6@18" VERT. BS SHALL BE ATTACHED TO CONTINUOUS LONGITUDINAL #6 BAR.
3- SEE APPROPRIATE DETAIL, SECTIONS & SECTIONS OF SPILLWAY WALLS.

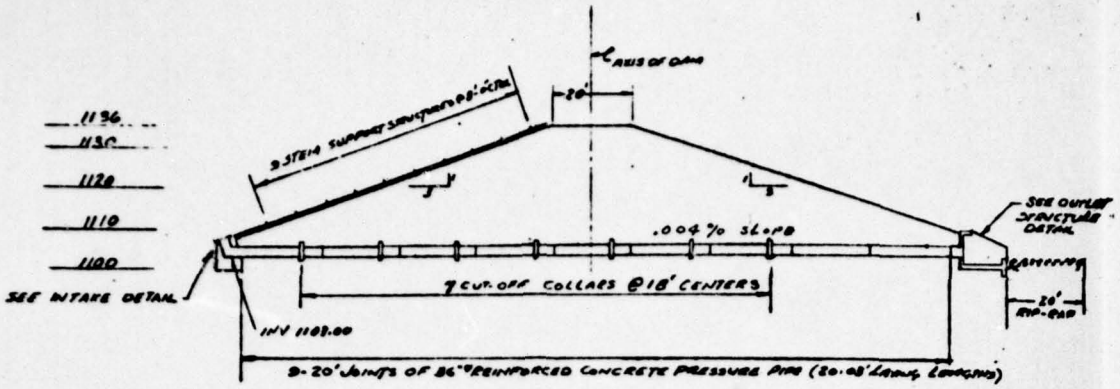
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE CHOCTAW DAM

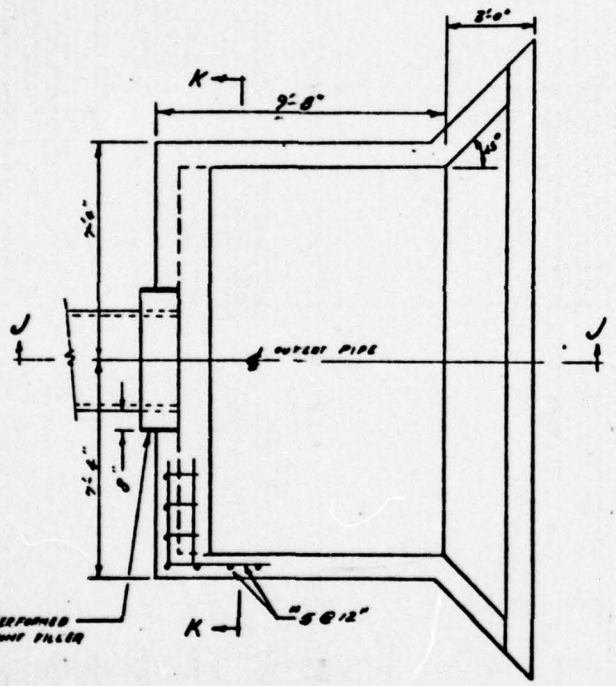
HIGH VISTA, INC.

SPILLWAY DETAILS
SHEET 2 OF 2

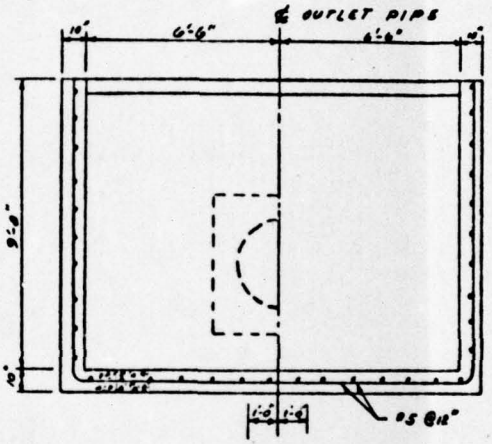
AUGUST 1978 PLATE 6



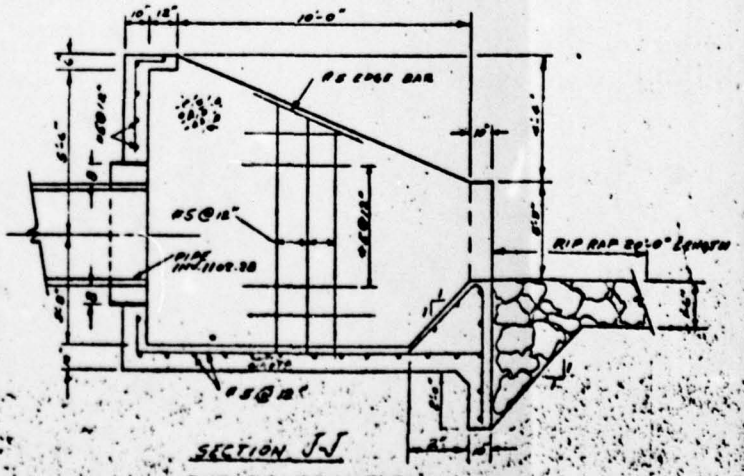
SECTION ON ℄ OF OUTLET PIPE
SCALE 1"=20'



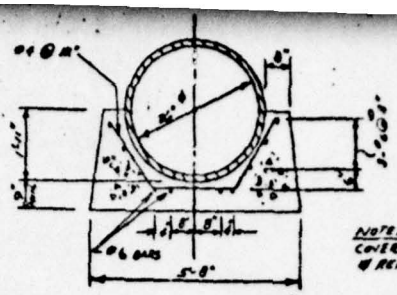
PLAN
SCALE ¾"=1'-0"



SECTION K-K
SCALE ¾"=1'-0"

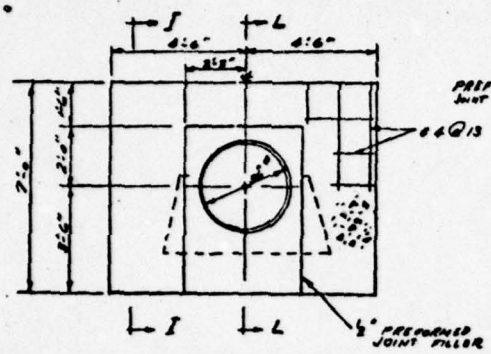


SECTION J-J
OUTLET STRUCTURE

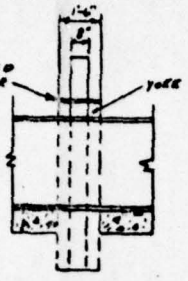


NOTE: MIN OF 2" COVER BETWEEN PIPE & REINF. BARS.

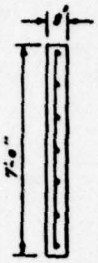
SCALE: 3/4"=1'-0"



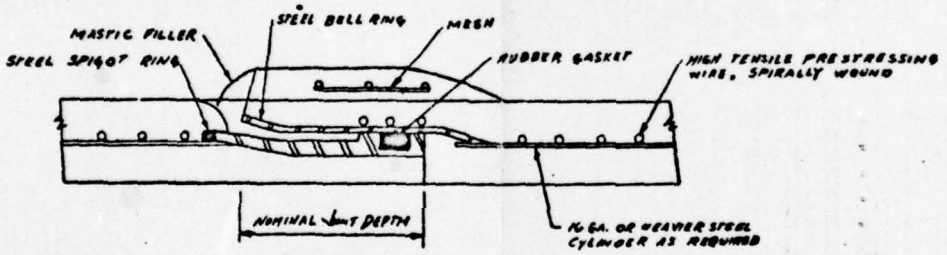
ELEVATION
CUT-OFF COLLAR
SCALE 3/4"=1'-0"



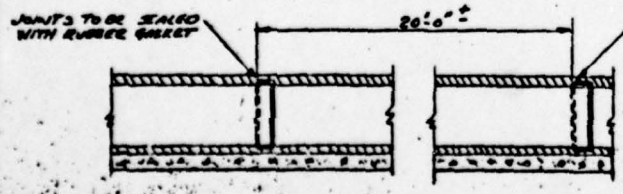
SECTION L-L



SECTION I-I



JOINT DETAIL
NO SCALE



SECTION OF OUTLET CONDUIT
SCALE 1/2"=1'-0"

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE CHOCTAW DAM

HIGH VISTA, INC.

OUTLET WORKS DETAILS

AUGUST 1978 PLATE 7

SUSQUEHANNA RIVER BASIN

LITTLE SUGARLOAF CREEK, SCHUYLKILL COUNTY

PENNSYLVANIA

LAKE CHOCTAW DAM

NDS ID No. PA-00819
DER ID No. 54-178

HIGH VISTA, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

AUGUST 1978

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: Lake Choctaw Dam

NDS ID NO.:PA-00819 DER ID NO.: 54-178

ITEM	REMARKS
AS-BUILT DRAWINGS	Complete set of construction drawings available.
REGIONAL VICINITY MAP	Project is not shown on USGS Maps. When updated, it will be shown on Nuremberg, Pennsylvania Quadrangle Sheet N 4052.5 - W7607.5 /7.5.
CONSTRUCTION HISTORY	Constructed 1973-1974 by High Vista, Inc.
TYPICAL SECTIONS OF DAM	Available.
OUTLETS: Plan Details Constraints Discharge Ratings	Plan and details available. No discharge ratings.

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	None.
DESIGN REPORTS	1972: Northeastern Engineering Company, Inc. Includes soils investigation, embankment design, filter design, and compaction specifications. 1972: Permit application report by PennDER.
GEOLOGY REPORTS	1972: Northeastern Engineering Company, Inc.; general and site geology.
DESIGN COMPUTATIONS: Hydrology and Hydraulics Dam Stability Seepage Studies	Final results of stability analyses and estimate of seepage; spillway designed for Curve "C" discharge.
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	Available.
POSTCONSTRUCTION SURVEYS OF DAM	None.

ENGINEERING DATA

ITEM	REMARKS
BORROW SOURCES	Within reservoir area.
MONITORING SYSTEMS	None.
MODIFICATIONS	None.
HIGH POOL RECORDS	None.
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	None.

ENGINEERING DATA

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	None.
SPILLWAY: Plan Sections Details	Available.
OPERATING EQUIPMENT: Plans Details	Available.
PREVIOUS INSPECTIONS Dates Deficiencies	None.

CHECKLIST

ENGINEERING DATA

HYDROLOGY AND HYDRAULICS

NAME OF DAM: Lake Choctaw Dam NDS ID NO.: PA-00819 DER ID NO.: 54-178

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): Elevation 1130.0

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): Elevation 1136.0

ELEVATION MAXIMUM DESIGN POOL: Elevation 1136.0

ELEVATION TOP DAM: Elevation 1136.0

SPILLWAY CREST:
- a. Elevation 1130.0
- b. Type Concrete ogee with chute and stilling basin.
- c. Width Not applicable.
- d. Length 55 feet.
- e. Location Spillover Right abutment.
- f. Number and Type of Gates None.

OUTLET WORKS:
- a. Type 36-inch RCP.
- b. Location 250 feet from right abutment.
- c. Entrance Inverts Elevation 1103.00
- d. Exit Inverts Elevation 1102.28
- e. Emergency Draindown Facilities Same as outlet works.

HYDROMETEOROLOGICAL GAGES:
- a. Type None.
- b. Location None.
- c. Records None.

MAXIMUM NONDAMAGING DISCHARGE: Unknown.

SUSQUEHANNA RIVER BASIN

LITTLE SUGARLOAF CREEK, SCHUYLKILL COUNTY

PENNSYLVANIA

LAKE CHOCTAW DAM

NDS ID No. PA-00819
DER ID No. 54-178

HIGH VISTA, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

AUGUST 1978

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: Lake Choctaw Dam County: Schuylkill State: Pennsylvania

NDS ID No.: PA-00819 DER ID No.: 54-178

Type of Dam: Earthfill Hazard Category: High

Date(s) Inspection: 27 June 1978 Weather: Clear Temperature: 90°

Rain on previous evening.

Pool Elevation at Time of Inspection: 1136.1 msl/Tailwater at Time of Inspection: 1099.0 msl

Inspection Personnel:

D. Wilson (GFCC)	N. Cunfer (High Vista)	
D. Wolf (GFCC)	J. DaGrosa (High Vista)	
D. Ebersole (GFCC)		

D. Wilson (GFCC) Recorder

EMBANKMENT

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION: Embankment Slopes Abutment Slopes	1. Damaged area on upstream slope 25 feet left of spillway. 2. Some minor erosion gullies on downstream slope.	1. 15 feet wide; maximum of 2 feet below adjacent slopes; unknown cause. 2. Less than 1-foot deep.
CREST ALIGNMENT: Vertical Horizontal	1. Horizontal - No irregularities 2. Vertical - crest elevation varies from El. 1135.1 at 25 feet left of spillway to El. 1136.8.	2. Average top elevation is about 0.1 - 0.2 foot below design elevation.
RIPRAP FAILURES	1. Riprap good except at 25 feet left of spillway. Light brush among riprap. 2. Crest - no cover. 3. Downstream slope - vegetation started but not developed.	1. Riprap 18-inch conglomerate; riprap to top of dam except at area near spillway.

EMBANKMENT

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT WITH: Abutment Spillway Other Features	1. Spillway - no abnormalities. 2. Left abutment - no abnormalities.	
ANY NOTICEABLE SEEPAGE	1. Wet area at toe 200 feet from left abutment; slight standing water; no flow. 2. Small watercourse begins beyond toe near center; toe gutter joins watercourse.	1. Area not excessively soft; could be result of surface runoff. 2. Flow about 0.5 gpm; clear; appears to be runoff.
STAFF GAGE AND RECORDER	None.	
DRAINS	Toe drain has 2 8-inch diameter BCCMPS entering sides of outlet works outlet structure.	Right outlet was dripping; left outlet was dry.

OUTLET WORKS

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None.	Conduit in good condition.
INTAKE STRUCTURE	Not visible (submerged).	
OUTLET STRUCTURE	Concrete excellent. No accumulations of soil in outlet structure.	
OUTLET CHANNEL	Has 12 - 18 inch riprap from outlet structure to 50 feet beyond where it meets the spillway channel.	Riprap placement not uniform; some gaps; no apparent erosion.
EMERGENCY GATE	One gate at intake structure; gate stand at top of dam. Stem in oil-filled casing. 3:1 reducer.	Gate stand was painted; stem enclosed and has dial type indicator; opened about 1/3 full easily; Owner operates every six months.

UNGATED SPILLWAY

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Ogee type; good condition; all joints sealed.	Algae growth on concrete surfaces; was scraped away and concrete appeared to be normal.
APPROACH CHANNEL	Clear; no debris; no operating constraints.	Concrete approach walls excellent condition; no cracks; joints sealed.
DISCHARGE CHANNEL (Concrete Chute)	Excellent condition.	Algae growth on concrete surfaces.
BRIDGE AND PIERS	None.	

INSTRUMENTATION

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	

RESERVOIR AND WATERSHED

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Slopes about 1V on 8H; no signs of instability.	
SEDIMENTATION	No problem reported by Owner.	
WATERSHED DESCRIPTION	Owned entirely by High Vista, Inc.; all wooded; most of watershed will be developed.	High Vista, Inc. has restrictions on development so that trees may be removed only to construct house.
UPSTREAM DAMS	1. Lake Susquehanna Dam located 0.4 mile upstream. 2. Lake Calumet Dam located just above Lake Susquehanna Dam-presently breached.	1. 50 - feet high. 2. High Vista, Inc. has tentative plans to rehabilitate this dam.
WATER QUALITY	Acid mine drainage enters Sugarloaf Creek just below Lake Susquehanna Dam; estimated flow 100-200 gpm from mine tunnel.	Owner reported that pH of Lake Choctaw reaches minimum of 3.8-4.0.

DOWNSTREAM CHANNEL

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: Obstructions Debris Other	No visible obstructions.	
SLOPES	No apparent erosion.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	Presently about eight houses between dam and Catawissa Creek.	High Vista plans to build another dam downstream and develop that area.

SUSQUEHANNA RIVER BASIN

LITTLE SUGARLOAF CREEK, SCHUYLKILL COUNTY

PENNSYLVANIA

LAKE CHOCTAW DAM

NDS ID No. PA-00819
DER ID No. 54-178

HIGH VISTA, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

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APPENDIX C

HYDROLOGY AND HYDRAULICS

Classification

The hazard classification is high since the downstream population is 150. (p.D.-9 Recommended Guidelines For Safety Inspection of Dams)

The Size classification is small since the height is 32 ft. and the capacity is 90 million gallons (276 Acre-Ft). (pD-8 Recommended Guidelines For Safety Inspection of Dams).

Spillway Design Flood

The spillway design flood should be ½ PMF to PMF for a small size high hazard dam. (Ref- pD-12 Recommended Guidelines for Safety Inspection of Dams). Use the PMF for the spillway design flood since h=32 is close to the class limit of h=40.

Hydrologic and Hydraulic Analysis

As shown on Plate 1, Choctaw Lake Dam is not ideally situated because Lake Susquehanna Dam is immediately upstream. The analysis procedure will be to analyze the Choctaw Lake Dam for two cases which may cause overtopping failure.

Case 1: Consider a storm over the entire Lake Choctaw watershed. Include the natural reduction of the Lake Susquehanna component.

Case 2: Consider a PMF for Lake Susquehanna to investigate the effect of a potential failure of Lake Susquehanna Dam on Lake Choctaw Dam

Reference - Phase 1 Procedure Package

A.1. PMF inflow hydrograph is not available.

2. As per contact with NAB, Susquehanna River Basin Region 2 curve is to be used for the PMF peak, and Vol = 24" of runoff.

$PMF\ peak = 2.55\ Mi^2 \times 2580 \frac{cfs}{Mi^2} \approx \underline{6580\ cfs}$

$Vol = 2' \times 2.55\ Mi^2 \times 640 \frac{Acres}{Mi^2} = \underline{3264\ Ac\text{-}ft.} \times \frac{43560}{3600} = 39494\ cfs\text{-}hr.$

$b = 39494\ cfs\text{-}hrs \times \left(\frac{2}{6580\ cfs}\right) = \underline{12.0\ hrs}$

<u>case 1: Lake Susquehanna Dam Component of PMF</u>

$PMF_{susq} = PMF_{CHOCTAW} - PMF_{susa-CHoctaw}$

Area Between Choctaw & Susquehanna = $2.55 - 1.89 = 0.66\ Mi^2$

$PMF_{susa-CHoctaw} = 6580\left(\frac{0.66}{2.55}\right)^{0.8} = 2230\ cfs.$

$PMF_{susq} = 6580 - 2230 = \underline{4350\ cfs.}$

$b = \underline{12\ hrs}$

$Vol = \frac{1}{2} \times 4350 \times 12 \times \frac{3600}{43560} = \underline{2160\ Acre\text{-}ft.}$

B.1. Ability of Susquehanna spillway to pass its component of the Choctaw PMF.

Max capacity of Susquehanna Spillway = <u>2290cfs</u>
(Phase 1 Inspection Report "Susquehanna Dam")

3. The Lake Susquehanna component of the Lake Choctaw PMF is greater than the Spillway capacity. 4350 cfs > 2290 cfs

b. routing of the Lake Susauehanna component of the PMF is unavailable.

(1) Percent of Flood which will pass the spillway

$2290/4350 = 0.526 = P$

(2) Estimate the storage effect of the reservoir

(Reference - Inclosure 3 Method - NAB)

$\Delta AOC = (1-P) \times \Delta AOB$

$= (1-0.526) \times 2160$ Acre-ft

$=$ 1024 Acre-ft required surcharge storage

For Lake Susquehanna - assume that a right circular cone with 8H on 1V side slopes will model the storage

$A_1 = 44$ acres $= \pi r_1^2$ $\therefore r_1 = 781.08$ ft

$\Delta r = 8\Delta V = 8 \times 5.4 = 43.20$ ft

$r_2 = 824.28$ ft.

At Top of Dam

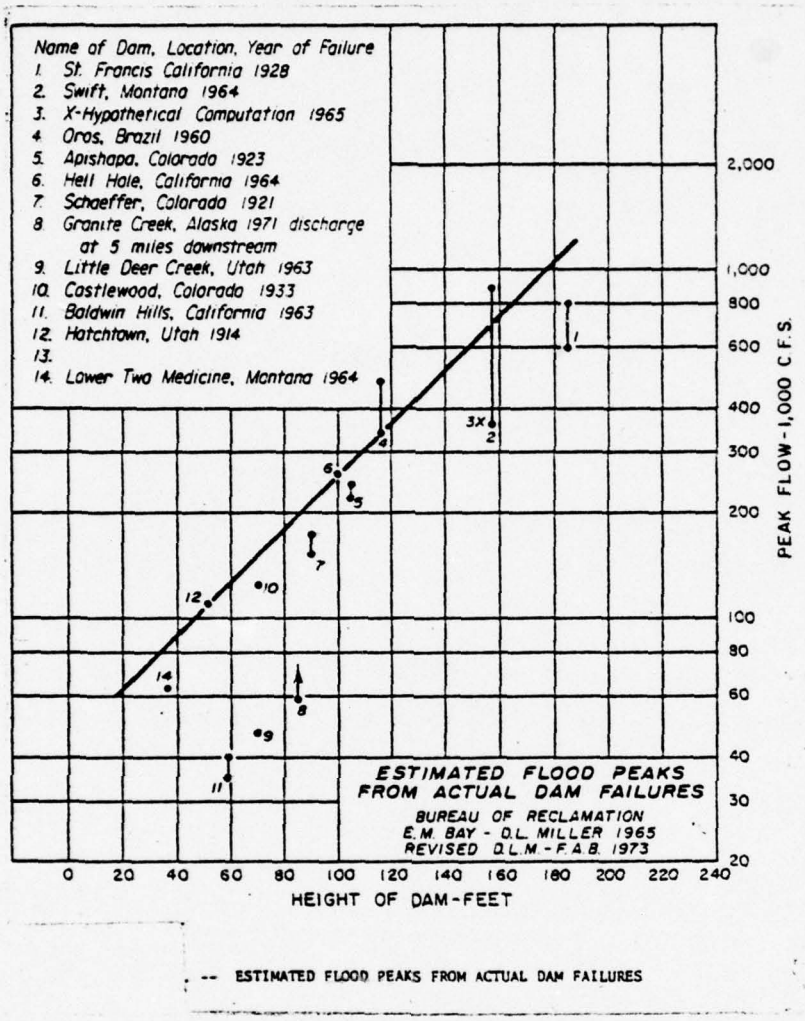
$A_2 = \pi r^2 = \pi \times 824.28^2 \div 43{,}560 = 49$ Acres

$\Delta V = \left(\frac{44+49}{2}\right) \times 5.4 =$ 251.1 Acre-ft. avail. surcharge storage

The surcharge storage required is greater than the surcharge storage available. Failure of Lake Susque-hanna Dam due to overtopping can be assumed for an occurrance of the Susquehanna component of the Lake Choctaw PMF.

Estimate The Effect of Overtopping Failure of Lake Susquehanna Dam.

flood hydrograph peak - 90,000 cfs. (Ref - Selecting Spillway Floods For Existing Structures, Fredrick A. Bertle, "Inspection, Maintenance, and Rehabilitation of Old Dams," ASCE, pp 328-336



Storage Volume of Lake Susquehanna

$V = 200{,}000{,}000$ gallons + 251 Acre-ft
$= 614$ Acre-Ft + 251 Acre-ft. = **865 Acre-ft.**

$= 10{,}466$ cfs-hrs.

$A = \frac{1}{2} b h = 10{,}466 = \frac{1}{2} b \times 90{,}000$
$\therefore b = 0.232 \text{ hrs} \approx 13.9 \text{ min.}$

Ability of Choctaw Lake Spillway to pass failure hydrograph from Lake Susquehanna.

1. Capacity of Choctaw Spillway

Length = 55'

H = 5.1' (1135.1 Top of dam − 1130.0 weir crest)

Ogee Section

from - "Design of Small Dams"

$3.30 = X_5 = 0.880\,H_0 \rightarrow H_0 = 3.75'$

$10.60 = R_5 = 2.8\,H_0 \rightarrow H_0 = 3.78$

$0.58 = X_4 = 0.154\,H_0 \rightarrow H_0 = 3.77$

$5.19 = R_4 = 1.410\,H_0 \rightarrow H_0 = 3.68$

$1.99 = R_2 = 0.53\,H_0 \rightarrow H_0 = 3.75$

$0.88 = R_1 = 0.235\,H_0 \rightarrow H_0 = 3.74$

∴ Assume that the design head (H_0) is 3.75' and

$$Q = 3.87 \times 55 \times (3.75)^{3/2} = 1546 \text{ cfs}$$

↳ @ $\frac{P}{H_0} = \frac{3.09}{3.75}$ (p 378)

@ 5.1' of head

$$\frac{H_e}{H_0} = \frac{5.1}{3.75} = 1.36, \quad \frac{C}{C_0} = 1.043$$

$$Q = 1.043 \times 3.87 \times 55 \times (5.1)^{3/2} = \underline{2556 \text{ cfs}}$$

2. The failure inflow peak is greater than the spillway capacity 90,000 > 2556

b. The routing of the failure hydrograph is unavailable

(1) Percent of failure hydrograph which will pass the Choctaw Spillway = 2556/90,000 = 0.028 = P

(2) Estimate of the storage effect of the reservoir (Reference - Inclosure 3 method)

$\Delta AOC = (1-p)\,\Delta AOB$

$= (1-0.028)(865\ \text{Acre-ft}) = \underline{841\ \text{Acre-ft.}}$

Assume that a right circular cone with 8H on 1V side slopes will adequately model the reservoir.

$A_1 = 23\ \text{Acres} = \pi r_1^2 \quad \therefore r_1 = 564.7\ \text{ft}$

$\Delta r = 8 \cdot \Delta Y = 8 \times 5.1 = \underline{40.8\ \text{ft}}$

$r_2 = 605.5\ \text{ft}$

At top of Dam

$A_2 = \frac{\pi}{43,560} \times (605.5)^2 = 26.4\ \text{Acres}$

Estimated Surcharge Storage

$S = \left(\frac{23+26.4}{2}\right) \times 5.1 = \underline{126\ \text{Acre-ft.}}$

Surcharge Storage Required is greater than the storage available. 840. > 126.

Conclude: At the PMF storm - an overtopping failure is expected to occur at the Lake Susquehanna Dam. A failure hydrograph from Lake Susquehanna cannot pass the Lake Choctaw Dam without causing an overtopping condition.

C.2.a Adequacy of Spillway

ETL 1110-2- States that three conditions must exist before spillway capacity is considered to be seriously inadequate.

b. Check condition "C" Ability of spillway to pass ½ PMF without overtopping

Component	PMF	½ PMF
Susq.	4350	2175
Choctaw - Susq	2230	1115
Choctaw	6580	3290

Consider first, what happens at Lake Susquehanna when the Lake Choctaw ½ PMF occurs.

Max. Capacity of Lake Susquehanna = 2290 cfs

* ∴ Lake Susquehanna Spillway will not overtop

$L = 45'$, $H_0 = 3.75$ $H_s = 1190.0$

H	$C/C_0 \cdot C_0$	Q	Δr	A_2	S	$\frac{2S}{T}$	$O + \frac{2S}{T}$
2	3.587	457	16	45.8	89.8	181	638
3	3.76	880	24	46.7	136.1	274	1154
4	3.89	1400	32	47.7	183	370	1770
5	4.03	2026	40	48.6	231	467	2493
5.4		2290		49	251		2796

$\therefore H = 4' + \left(\frac{2175 - 1770}{2493 - 1770}\right) + 4' - 4.56'$

and $Q = 1.028 \times 3.87 \times 45 \times (4.56)^{3/2} = 1740$ cfs

Surcharge storage utilized = $^{4.56}/_{5.00} \times 231 = 210$ acre-ft

Assume that 1. the peak outflow from Lake Susquehanna is coincident with the peak of the ½ PMF runoff from the area between the two dams

2. the base is 12 hrs.

* Note: Since Lake Susquehanna Dam will not be overtopped, it is necessary to compute the outflow from Susquehanna and the amount of surcharge storage in Susquehanna that is actually utilized in passing an inflow of 2,175 c/s

$Q_p = 1740 + 1115 = 2855$ cfs
$b = 12$ hrs
Vol = 17130 cfs-hrs = 1416 Acre-Ft = 10.41" of runoff

2. the $\frac{1}{2}$ PMF peak is greater than the spillway capacity $2855 > 2556$
   b. the routing of the $\frac{1}{2}$ PMF is unavailable
      (1) fraction of failure hydrograph which will pass Choctaw Spillway

$$p = 2556 / 2855 = 0.895$$

      (2) Estimate of storage effect
$\Delta AOC = (1-p)\,\Delta AOB$

$\Delta AOC = (1-0.895) \times 1416 = 148.7$ Acre-Ft.
SAY $\simeq 149.0$ " "

The available surcharge storage is less than the required surcharge storage $149 > 126$

% of PMF which will pass Lake Choctaw

$$\% = \frac{\text{Choctaw Spillway Cap} + \frac{2 \Sigma S}{T}}{\text{Choctaw PMF}} \times 100$$

$$= \frac{2556 + \left[\frac{2 \times (210^{*} + 126^{**}) \times 43560}{12 \times 3600}\right]}{6850} \times 100$$

$$= \underline{47.2\ \%}$$

* 210 = actual surcharge storage utilized (page C-7)

** 126 = surcharge storage available in L. Choctaw

Case 2 PMF Storm occurring on Lake Susquehanna Watershed

$$PMF_{peak} = 2690 \frac{cfs}{Mi^2} \times 1.89\ Mi^2 = 5084\ cfs$$

Say 5080 cfs

$$Vol = 2' \times 1.89\ Mi^2 \times 640 \frac{Acres}{Mi^2} = 2419\ Acre\text{-}ft. = 29{,}272\ cfs\text{-}hrs$$

$$b = 29{,}272 \times \left(\frac{2}{5080}\right) = 11.52\ hrs$$

Lake Susquehanna Spillway Capacity = 2290 cfs
Available Surcharge Storage = 2511 Acre-ft.

2. The PMF peak flow is greater than the spillway capacity $5080 > 2290$

b. the routing of the PMF is not available

(1) Percent of the PMF which is capable of passing the spillway

$$p = (2290 \div 5080) \times 100 = 45.1\ \%$$

(2) Storage Effect

$\Delta AOC = (1-P)\Delta AOB$

$= (1-0.451)(2419) = 1328$ Acre-ft. required

there is 251.1 Acre-ft of surcharge storage available as calculated for case 1, p 3.

Storage Required > Storage available

(1328 > 251.1)

The surcharge storage required is greater than the storage availableat Susquehanna Lake. Failure of Susquehanna Dam can be assumed for an occurrance of the PMF for the Lake Susquehanna PMF. The resulting failure hydrograph cannot pass the Lake Choctaw spillway without causing an overtopping condition(see case 1).

½ PMF STORM occurring on the Lake Susquehanna Watershed (Assume no inflow from intervening area)

½ PMF = 5080/2 = 2540 cfs

Vol = 1209 Acre-ft = 14,636 cfs-hrs

b = 11.52 hrs.

Available Surcharge Storage = 251.1 Acre-Ft

Spillway Capacity = 2290 cfs

2. The ½ PMF peak flow is greater than the spillway capacity

(2540 > 2290)

b. The routing of the ½ PMF is not available

(1) Percent of the ½ PMF which is capable of passing the spillway = (2290/2540) = 0.902

(2) Storage Effect

$\Delta AOC = (1-P)\Delta AOB$

$= (1-0.902)(1209) = 118$ Acre-Ft. < 251.1 Acre-Ft.

∴ Lake Susquehanna can pass the ½ PMF

The outflow from Lake Susquehanna when its ½ PMF occurs is

$$H = 5 + \left(\frac{2540 - 2493}{2796 - 2493} \times 0.4\right) = 5 + 0.1 = 5.1'$$

$$\frac{H_e}{H_o} = \frac{5.1}{3.75} = 1.36 \Rightarrow C/C_o = 1.043$$

$$Q = 1.043 \times 3.87 \times 45 \times (5.1)^{3/2} = 2092 \text{ cfs}$$

2092 cfs < 2556 ∴ Lake Choctaw Dam can pass the resulting outflow hydrograph from a ½ PMF storm for Lake Susquehanna

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Choctaw Lake Dam FILE NO. 7613.43
Hydrology and Hydraulics SHEET NO. 12 OF 13 SHEETS
FOR USCE - Baltimore
COMPUTED BY DAW DATE 7-78 CHECKED BY FFM DATE 8-78

Effect of Filling Low Spot on Embankment.

Spillway Capacity

design top of dam	1136.0
spillway crest	1130.0
available head	6.0

$\frac{He}{Ho} = \frac{6}{3.75} = 1.60 \Rightarrow \frac{C}{C_o} = 1.07$

$Q = 1.07 \times 3.87 \times 55 \times (6)^{3/2} \simeq 3347 cfs$

say 3350 cfs

Surcharge Storage

$\Delta r = 8 \times 6 = 48$ ft.

$r_2 = 588.8 + 48 = 636.8$

$A_2 = \pi (636.8)^2 / 43560 = 29.2$ Acres

$V = 6 \times \left(\frac{23 + 29.2}{2}\right) = 175.2$ Acre-Ft

$\therefore Q = 3350 + \frac{2 \times (^{*}210 + ^{**}126) \times 43560}{12 \times 3600} = 4030 cfs$

This is $\frac{4030}{6530} \times 100 = 61.2\%$ of the PMF

* 210 = actual surcharge storage of L. Susquehanna utilized (See Sheet C-7)

** 126 = surcharge storage available in L. Choctaw

SP 11860A

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HARRISBURG, PA.

SUBJECT Choctaw Lake Dam FILE NO. 7613.48
Hydrology and Hydraulics SHEET NO. 13 OF 13 SHEET
FOR USCE - Baltimore
COMPUTED BY DAW DATE 7-78 CHECKED BY FFM DATE 8-78

Tailwater Elev. at Spillway Capacity

a. Tailwater Depth = 6.28 ft HEC-2 computer run
b. Top of Dam Elevation = 1135.9 GFC&C survey
c. Bottom of Dam Elev. = 1100.0 "
d. Tailwater Elev. = 1106.3
e. $\Delta H = b - d$ = 29.6 feet.

SP 11860A

SUSQUEHANNA RIVER BASIN

LITTLE SUGARLOAF CREEK, SCHUYLKILL COUNTY

PENNSYLVANIA

LAKE CHOCTAW DAM

NDS ID No. PA-00819
DER ID No. 54-178

HIGH VISTA, INC.

PHASE I INSPECTION REPORT

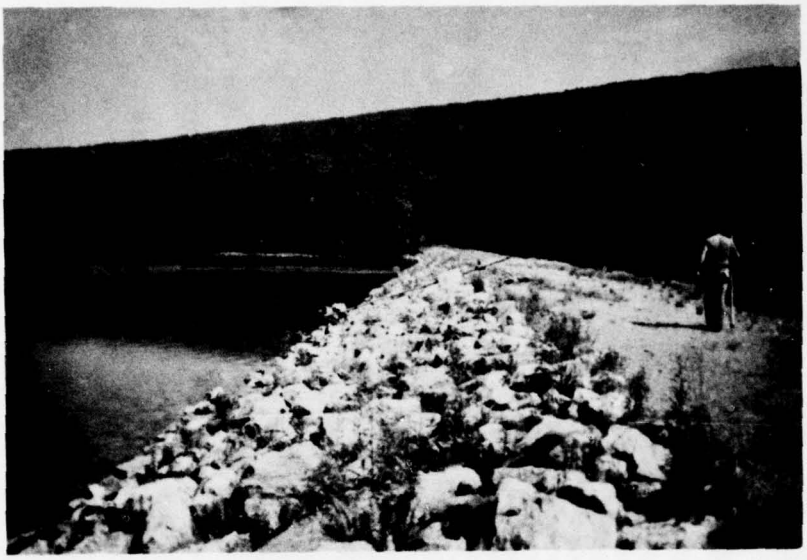
NATIONAL DAM INSPECTION PROGRAM

AUGUST 1978

APPENDIX D

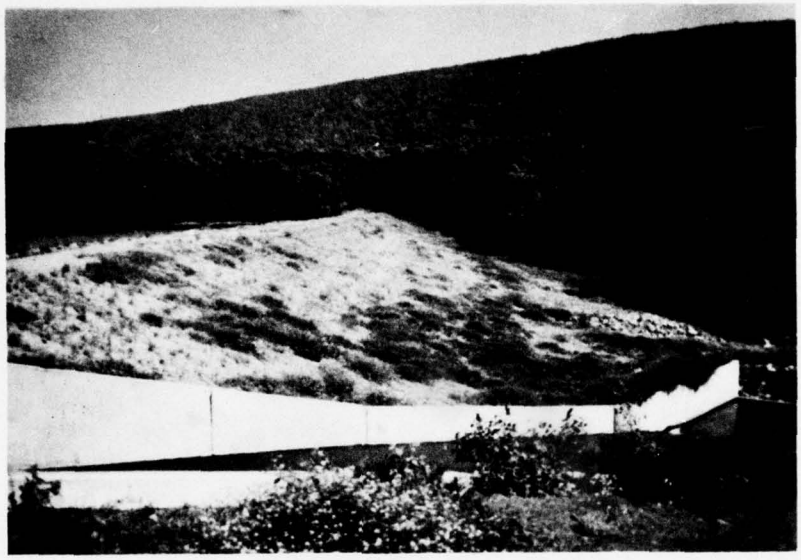
PHOTOGRAPHS

LAKE CHOCTAW DAM



A. Upstream Slope of Embankment.

B. Low Area on Embankment Near Spillway.



C. Downstream Slope of Embankment with Spillway Chute in Foreground.

D. Downstream Slope of Embankment.

E. Spillway Approach Channel and Weir.

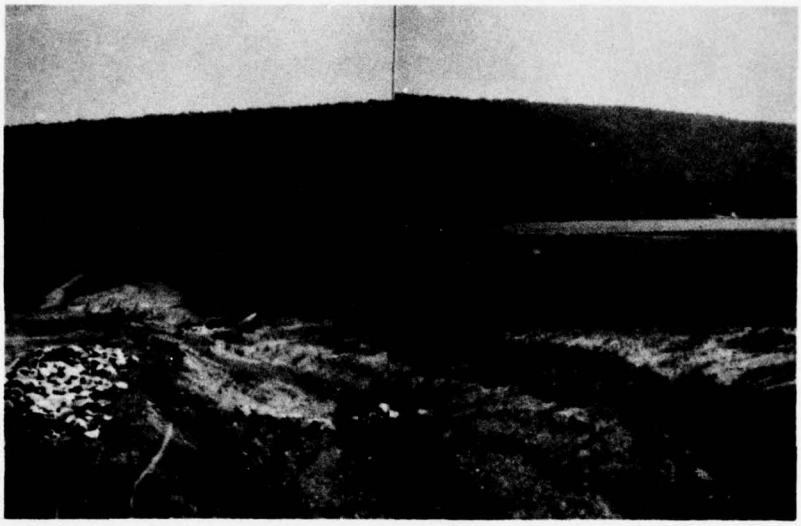
F. Spillway Chute and Stilling Basin.

G. Gate Stand on Top of Dam.

H. Outlet Works During Operation of Slide Gate.

J. Wet Area at Toe of Embankment
200 Feet from Left Abutment.

K. Mine Tunnel Opening on Left Hillside
0.4 Mile Upstream.



L. Lake Susquehanna Dam
Located 0.4 Mile Upstream.

M. Lake Calumet Dam.
Located Upstream from Lake Susquehanna Dam.
Breached Area of Embankment is at Center.

SUSQUEHANNA RIVER BASIN

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APPENDIX E

GEOLOGY

LAKE CHOCTAW DAM

APPENDIX E
GEOLOGY

1. General Geology. The damsite and reservoir are located on the border between Luzerne and Schuylkill Counties. The rock formations exposed in Luzerne County range from the post-Pottsville formations of Pennsylvania Age, down to the Onondaga formation, of Middle Devonian Age. In Schuylkill County, the exposed rock formations range from the post-Pottsville to Onondaga formations of Luzerne County down to Tuscarora sandstone of Silurian Age in the southern part of the county. The Wisconsin terminal moraine which covered the greater part of Luzerne County with glacial drift, terminates slightly north of this border area. Otherwise, the geology of this border area is more closely related to the geology of Luzerne County than it is to Schuylkill County.

Nearly all of Luzerne County lies in the Valley and Ridge Province in which nearly all the rocks have been strongly folded. In going from north to south across the County, five major folds are encountered, all of which trend northeast. The first of these is a shallow syncline on the crest of North Mountain, forming the Mehoopany coal basin. The second is the Milton Anticline, which exposes the Portage group in the northwestern part of the County and gradually flattens out toward the northeast. The third and most pronounced is the Lackawanna Syncline, which originates in Lackawanna County to the north, and has preserved the post-Pottsville formations throughout the Wyoming Valley. The maximum depth of this syncline is reached in the vicinity of Wilkes-Barre and Plymouth. The double rim of this syncline is formed by the resistant Pottsville formations and Pocono sandstone, separated by the less resistant Mauch Chunk shale. The fourth fold is the Berwick (Montour) Anticline, which exposes a few feet of the Onondaga formation in the vicinity of Beach Haven. This fold reaches its maximum development farther west and only the eastern portion reaches Luzerne County. The fifth major fold comprises a series of anticlines and synclines forming the Eastern Middle Anthracite Field in the vicinity of Hazelton. The synclinal basins in this region are relatively shallow and there are large areas from which all coalbeds have been eroded. The dam site and reservoir are located in such an area.

The general dips of the region vary from 0^{o} to 40^{0}, and the maximum dips are found on the rims and within the synclinal coal basins. The relatively soft post-Pottsville beds in their cores are severely folded and contorted with numerous minor faults. The northern and easternmost parts of the County border the Appalachian Plateau Province and are characterized by horizontal, or nearly horizontal strata. The Catskill continental group of rocks underlies those parts of Luzerne County that are outside of the five major folds.

2. Site Geology. The project area is located on the western edge of the Eastern Middle Anthracite Field. The dam site itself is underlain by the Mauch Chunk red shale formation which forms the abutments at both ends of the dam. The bedrock is overlain by a soil blanket that varies from 20 to 45 feet in depth, with the deeper soils located in the center of the valley. The decomposed shale topsoil consists generally of stratified layers of clayey sand (SC), clayey gravel (GM), sandy clay (CL) and sandy silt (ML), with the last named generally located adjacent to the bedrock. The Pottsville formation with mineable coal is found upstream, or north, of the damsite. A mine drainage tunnel discharges into the stream immediately upstream of the lake.